ANNALS

OF

SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

EDITED BY

LEWIS STEPHEN PILCHER, M.D., LL.D.,

OF NEW YORK.

WITH THE COLLABORATION OF

J. WILLIAM WHITE, M.D., LL.D.
OF PHILADELPHIA,
Professor of Surgery in the University of Pennsylvania.

SIR WILLIAM MACEWEN, M.D., LL.D.
OF GLASGOW,
Professor of Surgery in the University of Glasgow.

SIR W. WATSON CHEYNE, C.B., F.R.S.,
OF LONDON,
Professor of Surgery in King's College.

VOLUME L

JULY—DECEMBER, 1909

PHILADELPHIA

J. B. LIPPINCOTT COMPANY

1909

COPYRIGHT BY
J. B. LIPPINCOTT COMPANY
1909

CONTRIBUTORS TO VOLUME L.

BARLING, GILBERT, M.B., F.R.C.S., of Birmingham, England, Surgeon to the Birmingham General Hospital.

BASTIANELLI, PROF. RAFFAELE, of Rome, Italy.

BELL, JAMES, M.D., of Montreal, Canada, Professor of Surgery McGill University; Surgeon to the Royal Victoria Hospital.

BERNHEIM, BERTRAM M., M.D., of Baltimore, Md., The Hunterian Laboratory of Experimental Medicine, Johns Hopkins University.

BLAKE, JOHN BAPST, M.D., of Boston, Mass., Instructor in Surgery in Harvard University; Assistant Surgeon to the Boston City Hospital.

BREWER, GEORGE EMERSON, M.D., of New York, Surgeon to the Roosevelt Hospital.

BRISTOW, ALGERNON T., M.D., of Brooklyn, New York, Surgeon to the Long Island College, Kings County and St. John's Hospitals.

BRYAN, ROBERT C., M.D., of Richmond, Va., Professor of Descriptive Anatomy and Genito-Urinary Surgery in the University College of Medicine; Visiting Surgeon to Virginia Hospital.

BRYANT, JOSEPH D., M.D., of New York, Surgeon to Bellevue and St. Vincent's Hospitals.

BUERGER, LEO, M.D., of New York, Associate in Surgical Pathology and Assistant Adjunct Surgeon Mt. Sinai Hospital.

CHAFFEE, I. S., M.D., of Sharon, Conn.

CLARK, GEORGE O., M.D., of Boston, Mass.

COFFEY, ROBERT C., M.D., of Portland, Oregon.

COLEY, WILLIAM B., M.D., of New York, Attending Surgeon to the General Memorial Hospital; Attending Surgeon to the Hospital for Ruptured and Crippled.

CUSHING, HARVEY, M.D., of Baltimore, Associate Professor of Surgery in Johns Hopkins Hospital.

DAVIS, JOHN STAIGE, M.D., of Baltimore, Md., Assistant Surgeon to the Outpatient Department of the Johns Hopkins Hospital.

DEAVER, JOHN B., M.D., LL.D., of Philadelphia, Surgeon-in-Chief to the German Hospital.

DOBSON, J. F., M.S., F.R.C.S., of Leeds, Eng., Senior Assistant Surgeon to the Leeds General Infirmary.

DOWD, CHARLES N., M.D., of New York, Attending Surgeon to the General Memorial Hospital and St. Mary's Hospital for Children; Adjunct Professor of Clinical Surgery in Columbia University.

DOWNES, WILLIAM A., M.D., of New York, Associate Attending Surgeon to the New York Hospital; Assistant Surgeon to the General Memorial and St. Francis Hospitals; Instructor in Surgery Cornell University Medical College.

DUVAL, C. W., M.D., of Montreal, Canada.

216293

EBERTS, EDMOND M. VON, M.D., M.R.C.S.(Eng.), of Montreal, Surgeon to the Outpatient Department of the Montreal General Hospital.

EISENDRATH, DANIEL N., M.D., of Chicago, Ill., Professor of Surgery in the College of Physicians and Surgeons of Chicago; Attending Surgeon of the Michael Reese and Cook County Hospitals.

FINNEY, JOHN M. T., M.D., of Baltimore, Md., Associate in Surgery in the Johns Hopkins Hospital.

FREEMAN, LEONARD, M.D., of Denver, Colo., Professor of Surgery in Denver and Gross Colleges of Medicine.

FRIEDRICH, P. L., PROFESSOR DR., of Marburg, Germany, Professor of Surgery in the University of Marburg.

GIBBON, JOHN H., M.D., of Philadelphia, Professor of Surgery in Jefferson Medical College; Surgeon to the Pennsylvania Hospital.

GROVES, ERNEST W. HEY, M.S., F.R.C.S., of Bristol, England, Assistant Surgeon to the Bristol General Hospital; Surgeon to the Cossham Memorial Hospital.

GUTHRIE, DONALD, M.D., of Rochester, Minn., Clinical Assistant in St. Mary's Hospital.

HARTMANN, HENRI, M.D., of Paris, France, Professor in the Faculty of Medicine of Paris.

HARTWELL, H. F., M.D., of Boston, Mass., From the Pathological Laboratory of the Massachusetts General Hospital.

HENDERSON, M. S., M.B., of Rochester, Minnesota, Surgical Assistant at St. Mary's Hospital.

HITZROT, JAMES MORLEY, M.D., of New York City.

HOTCHKISS, LUCIUS W., M.D., of New York, Attending Surgeon to the Bellevue Hospital; Junior Surgeon to the Roosevelt Hospital.

HUME, JOSEPH, M.D., of New Orleans, La.

HUTCHINGS, WILLARD, M.D., of Detroit, Mich.

JAMIESON, J. KAY, of Leeds, Eng., Demonstrator of Anatomy in the University of Leeds.

JOHNSON, ALEXANDER B., M.D., of New York, Surgeon to the New York Hospital.

JONES, ROBERT, F.R.C.S., of Liverpool, Eng.

JUDD, JAMES R., M.D., of Honolulu, Hawaii.

KEETLEY, CHARLES B., F.R.C.S., of London, Eng., Senior Surgeon to the West London Hospital.

KELLY, HOWARD A., M.D., of Baltimore, Md., Professor of Gynæcologic Surgery in Johns Hopkins University.

LANE, W. ARBUTHNOT, M.S.(Lond.), F.R.C.S.(Eng.), of London, Surgeon to Guy's Hospital; Senior Surgeon to Hospital for Sick Children, Great Ormond Street.

LECONTE, ROBERT G., M.D., of Philadelphia.

LESTER, B. S., M.D., of Birmingham, Alabama.

LEWIS, JOSEPH S., M.D., Intern at the German Hospital in the City of New York.

LUCKETT, WILLIAM HENRY, M.D., of New York City.

MACEWEN, SIR WILLIAM, F.R.S., of Glasgow, Regius Professor of Surgery in the University of Glasgow.

MACKENZIE, KENNETH A. J., M.D., L.R.C.P. and S.E., of Portland, Oregon, Professor of Operative Surgery in the University of Oregon; Surgeon to St. Vincent's Hospital.

MACLAREN, ARCHIBALD, M.D., of Saint Paul, Minnesota, Professor of Clinical Surgery in the University of Minnesota.

MACLEAN, N. J., M.D., M.R.C.S(Eng.), of Winnipeg, Manitoba, Surgeon to St. Boniface Hospital and the Children's Hospital of Winnipeg.

MASON, J. M., M.D., of Birmingham, Alabama.

MAYO, CHARLES H., M.D., of Rochester, Minnesota, Surgeon to St. Mary's Hospital.

MAYO, WILLIAM J., M.D., Rochester, Minnesota, Surgeon to St. Mary's Hospital.

MCGRAW, THEODORE A., M.D., of Detroit, Mich., Professor of Surgery in the Detroit College of Medicine; Surgeon to St. Mary's and the Harper Hospitals.

MEARS, J. EWING, M.D., of Philadelphia.

MEYER, WILLY, M.D., of New York, Professor of Surgery at the New York Postgraduate Medical School and Hospital; Attending Surgeon to the German Hospital; Consulting Surgeon to the New York Skin and Cancer Hospital and New York Infirmary.

MORISON, RUTHERFORD, M.B., F.R.C.S., of Newcastle-on-Tyne, Senior Surgeon Royal Victoria Infirmary; Lecturer on Surgery and Operative Surgery University of Durham College of Medicine.

MOYNIHAN, B. G. A., M.S., F.R.C.S., of Leeds, England, Surgeon to the Leeds Infirmary.

MULLER, GEORGE P., M.D., of Philadelphia, Associate in Surgery in the University of Pennsylvania; Assistant Surgeon to the University Hospital; Consulting Surgeon to the Chester County Hospital.

MURRAY, FRANK W., M.D., of New York, Surgeon to the New York Hospital.

NANCREDE, CHARLES B. G. DE, M.D., Ann Arbor, Mich., Professor of Surgery in the University of Michigan and Dartmouth Medical College.

NEWMAN, SAMUEL E., M.D., of St. Louis, Mo.

OCHSNER, ALBERT J., M.D., of Chicago, Surgeon-in-Chief of Augustana and Saint Mary's Hospitals.

OPPENHEIMER, ADELE, M.A., of New York, Volunteer in Surgical Pathology, Mount Sinai Hospital.

PARHAM, FREDERICK W., M.D., of New Orleans, La.

PATERSON, HERBERT J., M.B., B.C.(Cantab.), F.R.C.S., of London, Assist-

ant Surgeon of the London Temperance Hospital, formerly Hunterian Professor of Surgery, Royal College of Surgeons.

PAUL, WALTER E., M.D., of Boston, Mass., Assistant Physician of Nervous Diseases to the Massachusetts General Hospital.

PECK, CHARLES H., of New York City, Attending Surgeon French Hospital; Junior Attending Surgeon Roosevelt Hospital; Adjunct Professor of Clinical Surgery in Columbia University.

PEDERSEN, VICTOR COX, M.D., of New York, Genito-urinary Surgeon of the Outpatient Department of the New York Hospital and House of Relief (Hudson Street Hospital).

PHELPS, CHARLES, M.D., of New York City, Surgeon to Bellevue and St. Vincent's Hospitals.

PORTER, CHARLES A., M.D., of Boston, Mass., Surgeon in the Massachusetts General Hospital.

POWERS, CHARLES A., M.D., of Denver, Colo.

PRIMROSE, ALEXANDER, M.B., C.M.(Edin.), M.R.C.S.(Eng.), of Toronto, Canada, Associate Professor of Clinical Surgery, University of Toronto; Surgeon, Toronto General Hospital.

RANSOHOFF, JOSEPH, M.D., F.R.C.S.(Eng.), of Cincinnati, Professor of Surgery in the Medical College of Ohio, University of Cincinnati.

ROVSING, THORKILD, M.D., of Copenhagen, Denmark, Professor of Clinical Surgery to the University of Copenhagen.

ROGERS, JOHN, M.D., of New York, Surgeon to the Gouverneur and St. Francis Hospitals.

SCUDDER, CHARLES L., M.D., of Boston, Mass., Surgeon to the Massachusetts General Hospital.

SHEPHERD, FRANCIS J., M.D., of Montreal, Canada.

SHERREN, JAMES, F.R.C.S., of London, Assistant Surgeon to the London Hospital; Surgeon to the Poplar Hospital for Accidents.

SMITH, CHARLES N., of Toledo, Ohio, Gynæcologist to St. Vincent's Hospital.

SMITH, EUGENE A., M.D., of Buffalo, N. Y., Adjunct Professor of Clinical Surgery in the University of Buffalo.

STOW, BOND, M.D., of New York, Pathologist to the Metropolitan Hospital of New York.

VAN METER, S. D., M.D., of Denver, Colo.

VANDER VEER, ALBERT, M.D., of Albany, New York, Professor of Surgery in the Albany Medical College.

WARE, MARTIN W., M.D., of New York City, Adjunct Surgeon to Mt. Sinai Hospital.

WIENER, JOSEPH, M.D., of New York, Adjunct Surgeon Mount Sinai Hospital.

WILSON, LOUIS B., M.D., of Rochester, Minn., Pathologist and Director of Laboratories in St. Mary's Hospital.

WROTH, PEREGRINE, JR., M.D., of Hagerstown, Md.

YOUNG, HUGH HAMPTON, M.D., of Baltimore, Md., Associate Professor of Genito-Urinary Surgery to the Johns Hopkins University; Associate in Surgery to the Johns Hopkins Hospital.

ANNALS OF SURGERY

VOL. L JULY, 1909 NO. 1

ORIGINAL MEMOIRS.

THE END RESULTS AFTER TOTAL EXCISION OF THE SCAPULA FOR SARCOMA.*

WITH STATISTICAL TABLES

BY CHARLES B. G. DE NANCREDE, M.D.,

OF ANN ARBOR, MICH.,

Professor of Surgery in the University of Michigan and in Dartmouth Medical College.

SOME thirty or more years ago, one of the most distinguished of English surgeons, the late Sir John Eric Ericsen, is credited with saying that we had practically reached finality in surgery—that there were no new fields to conquer, although of course improvements in technic, and therefore better results, were doubtless obtainable. Let us look back. What is left of the old surgery? Has not cerebral, gastric, hepatic, intestinal, pulmonary, and cardiac surgery been born and grown to lusty maturity since then? Are we assured against falling into error similar to that of Sir John Ericsen? Certainly not; and it seems to me that the bulk of the profession is tending to perpetuate certain errors by keeping their eyes too exclusively fixed upon improvements in mere technic, which really determines much of our miscalled modern success. Our wonderful immunity against wound infection, and our control of many of the factors making for dangerous shock, seems to me to be leading us to perform numberless operations

* Presidential address delivered before the American Surgical Association, Philadelphia, June 3, 1909.

upon the plea that if not fatal from hemorrhage and shock—mostly preventable—operative recovery is sure to occur; as if satisfactory "end results" were not more important than temporary recovery—a somewhat doubtful blessing for the victims of malignant disease.

Do we not compile our statistics rather to demonstrate the success of our technic, so far as the immediate risk to life is concerned, rather than to show by the "end results," *i.e.*, what benefit has accrued to the patient? Would it not be well to lay to heart some advice of Sir W. H. Bennett's which I will quote. "It is well that we should beware lest a single predominant factor should be allowed to lead to our regarding, through a small tube only, a subject the horizon of which is absolutely unlimited. It has been said that the basis of surgery is handicraft, and this, in a sense, is true; but surely it is truth only half told," for "lying behind certain issues" to which I have referred, "is a far greater thing—the knowledge of when to apply that craftmanship of which everyone who now aspires to the practice of surgery should make himself a master. Nothing that has happened in the improvements connected with the practice of our art justifies, so far as I know, the modification by one iota of the edict of the great surgeon, who before advancing science had robbed operations of most of their horrors, said: "The all-important thing is not the skill with which you use the knife, but the judgment with which you discern whether its employment is necessary or not." Substituting the word "technic" for "handicraft," and "is worth while" for "is necessary," this quotation epitomises the object of my address.

To appraise correctly the propriety of any operation we must not only ascertain the immediate mortality, but the *ultimate mortality*, from failure to really cure, before we subject our patients to useless risks. At least, we should be able to say that a certain number, however small, are cured, or that the interval before recurrence is likely to be long. No one recognizes more readily than I do how unreliable statistics are; but if with monotonous regularity the "end

result " is failure, at least we can be assured that this is vastly more likely to attend our future efforts than success, without any nice calculation of percentages,—and we shall cease to be self deceivers and blind leaders of our blinder but confiding patients.

In all business it is necessary to take stock from time to time, in order to ascertain whether our increasing income is a genuine return upon our invested capital, or whether we may not have impaired this and are gradually becoming bankrupt. So also in our profession it is wise to " take stock," as it were, to determine whether we really have made all the progress we claim, or whether, perchance, we have not diminished our capital of apparently well-grounded confidence, until the inevitable crash comes, revealing the true state of affairs, with its subsequent long-continued distrust of even conservative and genuine progress. This is well illustrated by the diametrically opposite advice given for the operative treatment of head injuries, during the eighteenth and nineteenth centuries. Should we find that real progress has been made, we can continue our practices; if partial advance alone has been secured, we must strive to render our success more complete; if real failure be the verdict of careful study, we must at once abandon that which has proved a broken reed, and start afresh in some new direction. Monumental conceit can alone oppose such periodic investigations, but those are unlikely to be welcomed with open arms who suggest the possibility that all which we now advocate and practice may not be good.

Following the example of one of my illustrious predecessors in this Presidential Chair, the late D. Hayes Agnew, instead of attempting to address you on some general subject, I shall strive to add my small contribution to the sum of more exact surgical knowledge. I have selected for investigation, total excision of the scapula for primary malignant disease. This of course practically means some form of sarcoma, since true carcinoma cannot be primary in bone. I am influenced in my choice because this is strictly a conservative opera-

tion for malignant disease of the bone, and because the local extirpation of all the neoplasm presents apparently most favorable conditions. Moreover, while not frequently performed, a sufficient number of cases are at everyone's disposal to guide us in deciding the following questions:

What are the probabilities as to operative death? Is there a material improvement in the numbers of the immediate survivals of the operations owing to our modern means for conserving blood? What are the chances for local recurrence, and are they early or late? Are early visceral metastases or recidives common? When operative recovery ensues, to what is the later death usually due? Is life much prolonged, and how much relief is effected by the operation? Can excision of the scapula be considered a curative operation, and if so, can this frequently be affirmed?

I shall endeavor to briefly settle for you these questions by the results of a study of all the recorded cases accessible to me in medical literature, and all unpublished cases with which the Fellows, and others have kindly supplied me by correspondence. A complete table of all unquestioned cases is appended, to enable the Fellows to review my conclusions if they so desire, and I must beg that they will judge of their correctness by glancing at the Tables (pages 8 to 17) as I read, these really constituting the body of my address.

I do not deny the possibility—indeed, the probability—that I have not secured reports of all total excisions of the scapula for malignant disease, and possibly more favorable results might thus be revealed if additional cases were unearthed, but after the exhaustive efforts I have made, I am convinced that no material change would be made in my conclusions.

A few words are requisite to explain the methods employed in the compilation of these tables, which differ widely from all their predecessors. Nothing so strongly impresses the conscientious student as the extraordinary inaccuracy of the tables purporting to be those of complete extirpations of the scapula. Many cases were really partial removals, or, sometimes, indeed complete removals, but done in two stages,

this latter method being a decidedly less dangerous operative procedure than complete removal at one sitting, although favoring local recidives and visceral metastases. Still further, cases are often admitted where portions of the clavicle or even the head of the humerus have been involved by the neoplasm and required removal; it is manifestly improper to include such cases in statistics purporting to be operations for disease restricted to the scapula, and is misleading as to the results of removal of the scapula alone.

A few cases have been included in my statistics where portions of the healthy clavicle,or even the head of the humerus have been removed. Such sacrifice of healthy bone tissue was to shorten the operation, to enable inadequate soft tissue flaps to cover the bones, or to mould the shoulder into better shape, not because of any trouble in the bones. Per contra in two instances in my tables small portions of the tip of the coracoid were left to facilitate operation, but in neither instance did these serve as the starting points for recidives, so far as is known (see cases of Gerster, No. 50, and of Bastiennelli, No. 59). It has seemed better to include these cases in the body of my statistics rather than to place them in the doubtful class, upon purely technical grounds.

In such cases it was thought that any increased risk of pyogenic or neoplastic infection of the cut osseous surfaces, or additional oozing, was more than counterbalanced by the greater certainty that no macroscopic diseased tissue was overlooked, and that the rapidity of the operation secured by cutting through, instead of disarticulating the clavicle or dissecting out the coracoid process, lessened both hemorrhage and shock. All such cases promptly recovered, thus showing that no additional operative risk was incurred.

Again, the most careful search throughout the whole domain of medical literature by myself and others, has failed to reveal any reliable information concerning certain cases found in nearly all tables. Their existence is not denied, only the propriety of quoting them is severely questioned. Even a case, which research showed was a removal of the scapula

after death, has been included by Karl Heldrich in his dissertation entitled, "Totale Resection der Scapula," München, 1903.

I can only attribute these blunders to the childlike confidence reposed by some in the accuracy of the headings of articles, inducing them to confine their researches solely to a perusual of the titles of reported cases, when a most cursory glance over the text would have shown the misleading character of these. In some few, the evidence advanced to prove that the disease was primary in, and confined to, the scapula has proved fallacious, a careful scrutiny of the history demonstrating that the neoplasm originated in contiguous muscles, this form of sarcoma being claimed by Butlin to be especially virulent as compared with bone sarcoma; these cases have been excluded or placed in the doubtful class. Contrary to the common practice, all cases where the microscopic picture and the subsequent clinical course proved that the growth was a pure enchondroma have been rigidly excluded from my tables. With still greater propriety, excisions for tubercular or pyogenic osteomyelitis and its consequences, are omitted, because in such cases if operative convalescence is secured, cure is effected, which certainly cannot be affirmed after operations for malignant disease. The inadequacy of the description of the microscopic appearances of one case of cyst of the bone following trauma, where no proper evidence of malignancy was supplied, led me to place this case in the "doubtful class."

Finally, from the later published reports, or by correspondence, some cases have been transferred from the cured class to the death column. From such researches I think that I am amply warranted in placing the question mark after cases which have made operative recoveries, but whose subsequent histories have extended only over a few months, and in some instances only a few weeks. The demonstrated inadequacy of the three years rule has led to its total disregard in this address, because a slavish and ignorant adherence to this artificial rule has led to many unwarranted statements upon which

has been founded erroneous practice. Under this rule recovery has been claimed while the reporter states that a late metastasis proved incapable of being radically treated.

All the statistics of the past, French, German, American, are absolutely misleading as to the operative mortality and end results of total excision of the scapula for primary sarcoma.

Although I have added twenty-two cases to those published in 1900 in Buchanan's tables, after a careful study of the literature by myself and two competent linguists, I have felt compelled to eliminate a number of cases, so that the total is slightly below that reported by Buchanan, for total extirpations, and upon which surgeons have relied since its publication in 1900. I wish here to acknowledge my indebtedness to this author both for his valuable tables and the information supplied me by his personal communications. I have also added two new cases to the second table comprising those where more than the scapula was involved in the malignant process.

A study of the 65 cases of malignant diseases tabulated, where the scapula alone seemed involved, has led to the surprising discovery that only one case is nearly certainly cured—MacDonald's, No. 39. Buchanan's case, No. 33, with hopeless metastases five years after excision of the scapula, should serve as a warning not to be over-sanguine. The following were probably cures, although in none had they been observed as long as Buchanan's. Case No. 4 of Syme's was well "several years" after the operation on the scapula, although this had been preceded by removal of the humeral head for a supposedly benign condition, and its admission to my list is perhaps of doubtful propriety.

Case No. 29 (Phelps) was believed to be well four years after amputation of the arm for recurrence. Cases 16, 38, 39, 46, 54, 60 and 61, were only followed for under four years. Accordingly we have one practically certain cure, and six probably cured, but one of these required a secondary operation and all may have relapsed later. Set against these

TABLE I.—END RESULTS AFTER TOTAL

No.	Operator	Date of operation	Sex Age	Condition for which operation was done	Operative results
1	J. Syme, Edinburgh..... Buchanan's list, No. 2	Oct. 1, 1856	F. 70 yrs.	Cystosarcoma	Recovery
2	F. von Esmarch, Kiel..... Buchanan's list, No. 6	May 9, 1859	M. 33 yrs.	Sarcoma	Recovery
3	A. Hammer, St. Louis..... Buchanan's list, No. 7	Oct., 1860	F. 18 yrs.	"Malignant growth" (Sarcoma)	Recovery
4	J. Syme, Edinburgh..... Buchanan's list, No. 8	Nov. 13, 1862	M. 45 yrs.	"Malignant growth" (Sarcoma)	Recovery
5	M. Michaux, Louvain..... Buchanan's list, No. 9	Nov. 24, 1864	M. 15 yrs.	"Encephaloma" (Sarcoma)	Recovery
6	S. Rogers, New York..... Buchanan's list, No. 11	Dec. 12, 1867	F. 7 yrs.	Carcinoma (Sarcoma)	Recovery
7	G. Pollock, London..... Buchanan's list, No. 13	Sept. 30, 1869	M. 47 yrs.	"Vascular growth" (Sarcoma)	Death
8	C. Steele, Bristol..... Buchanan's list, No. 14	April 18, 1871	F. 8 yrs.	Encephaloid (Sarcoma)	Recovery
9	K. King, Hull..... Buchanan's list, No. 15	June 17, 1871	F. 8 yrs.	Carcinoma (Sarcoma)	Recovery
10	J. Spence, Edinburgh..... Buchanan's list, No. 17	Feb. 21, 1872	M. 66 yrs.	"Malignant growth" (Sarcoma)	Recovery
11	R. Schnieder, Königsburg..... Buchanan's list, No. 19	Dec. 3, 1873	M. 6 yrs.	Sarcoma	Recovery
12	Wm. MacCormac, London Buchanan's list, No. 21	May 10, 1876	F. 29 yrs.	"Myxochondroma" Myxochondro-sarcoma (?)	Recovery

EXCISION OF THE SCAPULA FOR SARCOMA

Later history	End results	Remarks	Reference
No recurrence during two months, patient survived	Died in 2 m.	Exhaustion and old age, yet no adequate cause for exhaustion is given. Were there metastases in the organs essential to life?	Medico-Chirurgical Trans., London, 1857, vol. xl, p. 507.
Recurrence early	Died in 6 m.	Part of clavicle removed—apparently healthy—to facilitate operation	Archiv f. klin. Chirurg., 1863, vol. iv, p. 584
Recurrence early	Died 10 m. after operation	Three-fourths of inch of clavicle removed to facilitate operation	St. Louis Med. Rep., 1866, vol. i, p. 7.
No recurrence "several years later"	Recovery	Head of humerus had been previously removed for chondroma(?) It is somewhat questionable whether this case should be classed as an excision of the scapula in view of the previous operation	Syme, Excision of the Scapula, Edinburgh, 1864.
Rapid development of mediastinal growth	Death in 10 m.	.....	Gaz. Méd. de Paris, 1866, p. 313.
Rapid recurrence	Death in 6 m.	Carcinoma not being primary in bone, the growth must have been sarcoma	Amer. Journal Med. Sciences, 1868, vol. lvi, p. 359
Bronchopneumonia aggravated by the chloroform	Died on 5th d.	Part of clavicle removed because thought to be "slightly eroded." Were not the apparent bronchitic symptoms probably due to undetected pulmonary metastases giving rise to active symptoms from the irritant effects of chloroform?	St. George's Hospital Reports, 1869, vol. iv, p. 233.
Recurrence in less than seven weeks; this was removed but was followed by another in two weeks, which proved inoperable	Died middle of Sept. 1871, about 5 m.	Secondary operation at 7 weeks followed by hopeless recurrence	Brit. Med. Journal, 1871, vol. ii, p. 430.
No recurrence 2 years later	Recovery(?)	Too early for definite results, as many cases die from recurrence or metastasis much later	Liverpool and Manchester Med. and Surgical Reports, 1874.
(?)	Died in 6 m.	Careful scrutiny of the history shows that bronchitic(?) symptoms existed before operation, continued with varying intensity during so-called "convalescence," culminating in death from "capillary bronchitis;" no post-mortem. The whole pulmonary condition was almost certainly due to lung metastases preceding operation	Dublin Journal of the Medical Sciences, 1873, vol. lv, p. 508.
Generalization	Died in 4½ m.	Uninvolved portion of clavicle removed to facilitate operation	Berlin. klin Wochensch., 187, vol. xi, p. 377
Recurrence	Died Nov. 12, 1876, 6 m. after operation	Clavicle divided just internal to coracoid process for convenience. So-called myxochondromata contain genuine sarcomatous tissue if all portions of the growth are carefully examined in almost every instance	St. Thomas's Hospital Reports, 1876, vol. vii, p. 307.

TABLE I.—END RESULTS AFTER TOTAL EXCISION

No.	Operator	Date of operation	Sex Age	Condition for which operation was done	Operative results
13	J. Spence, Edinburgh..... Buchanan's list, No. 25	1877	.. ..	"Tumor"	Death
14	G. A. Peters..... Buchanan's list, No. 26	Jan. 11, 1878	M. 42 yrs.	Carcinoma (Sarcoma)	Recovery
15	F. A. Nixon..... Buchanan's list, No. 28	Nov., 1881	M. 13 yrs.	Sarcoma	Recovery
16	A. Roth, Cagliari..... Buchanan's list, No. 29	Jan. 14, 1884	M. 33 yrs.	Myxosarcoma	Recovery
17	Geo. W. Gay, Boston..... de Nancrède	Feb. 1, 1884	M. 23 yrs.	Sarcoma	Recovery
18	Mr. Ellison..... Buchanan's list, No. 30	July 7, 1884	M. 13 yrs.	Sarcoma	Recovery
19	Lannelongue..... Buchanan's list, No. 33	Mar. 5, 1885	M. 34 yrs.	Chondrosarcoma	Death
20	J. H. Brinton..... Buchanan's list, No. 34	Oct. 3, 1885	F. 11 yrs.	Sarcoma	Death
21	H. Trendelenburg, Bonn..... Buchanan's list, No. 37	Nov. 16, 1886	M. 42 yrs.	Sarcoma	Recovery
22	T. F. Chavasse, Birmingham.... Buchanan's list, No. 41	Feb., 1888	F. 8 yrs.	Sarcoma	Death
23	P. Sendler, Magdeburg..... Buchanan's list, No. 43	May 2, 1888	F. 23 yrs.	Sarcoma	Recovery
24	J. Van der Hoeven, Jr..... Buchanan's list, No. 44	Mar. 7, 1889	M. 4½ yrs.	Sarcoma	Recovery
25	M. Perier..... Buchanan's list, No. 45	Oct. 14, 1889	M. 55 yrs.	Sarcoma	Recovery
26	Putti..... Buchanan's list, No. 46	1889	M. 45 yrs.	Sarcoma	Recovery
27	J. Israel, Berlin..... de Nancrède	July 6, 1890	M. 38 yrs.	Sarcoma	Recovery
28	Hadra, Erlangen..... Buchanan's list, No. 48	Jan. 13, 1891	M. 59 yrs.	Sarcoma	Recovery
29	A. M. Phelps, New York..... Buchanan's list, No. 49	Nov., 1891	M. 42 yrs.	Fibroma by pathologists. Because of recurrence, growth was evidently fibrosarcoma	Recovery
30	Putti..... Buchanan's list, No. 50	1891	.....	Sarcoma	Recovery
31	W. H. A. Jacobson, London..... Buchanan's list, No. 51	March, 1892	F. Adult	Sarcoma	Recovery
32	M. Folet of Lille..... Buchanan's list, No. 53	April 14, 1893	F. 19 yrs.	Sarcoma	Recovery

OF THE SCAPULA FOR SARCOMA—*Continued*

Later history	End results	Remarks	Reference
.....	Died	Clavicle divided near acromial end to facilitate operation. Nothing beyond statement that operation was done and result	Lectures on Surgery, 3rd Ed., vol. ii, p. 1107.
No recurrence at last report at the end of 3 months	Recovery(?)	Too early for definite end results	Amer. Journal of Med. Sciences, 1878, vol. lxxvi, p. 100.
Last record only few weeks after operation	Recovery(?)	Too early for definite end results	Brit. Med. Journal, 1881, vol. ii, p. 1056.
No recurrence in 1888, according to Tito Costa in Buchanan's table	Recovery(?)	Reasonably certain recovery, although may have recurred later	Melis, Extirp. della Scapola, Cagliari, 1886; Arch. di Ortop. Anno 10, No. 2, 1893. Buchanan's letter to author
Recurrence and death inside of the year	Death in less than a year	.....	Personal letter to de Nancrède.
No record after report in journal	Recovery(?)	.....	Austral. Med. Gaz., 1884, vol. iv, p. 39.
.....	Died in 36 h. Shock	Alcoholic subject	Leçons clinique Chir., Paris, 1885, p. 235.
.....	Died 1 h. from shock	.....	Maryland Med. Journ., 1885–6, vol. xiv, p. 21.
Recurrences Feb. 8, 12, 26	Died in 18 m.	.....	Trottmann, Ueber die Extirp. der Scapula, 1887
.....	Died same day	.....	Lancet, London, 1892, vol. ii, p. 471.
Sarcomatosis of lung, local recurrence	Death on 14th day	.....	Arch. f. klin. Chirurg., 1889, vol. xxxviii, p. 300.
No recurrence at the end of 15 months	R(?)	Too early to determine end results	Nederl. Tydschr., v.. Geneesk, 1890, vol. xxvi, p. 521.
Last report Feb. 4, 1890	R(?)	Too early to determine end results	Le Mercredi méd., 1890, p. 51.
Lethal cause "Enterocolitis"	Died in 14 m.	Too early to determine end results	Riforma med. Napoli, May 1, 1891.
Sarcomatosis of liver, right pleura, and probably left lung	Died in 1 y.	.....	Berlin. klin. Wochenschr. vol. xxxiii Nov., p. 987–8.
Recurrence 1 month, operated. Second recurrence, operation attempted, abandoned	Died in 10 w. Sepsis	Head of humerus removed because of paucity of soft part covering	Hausmann, Ueber die totale extirpat. des Schulterblattes, 1892, Erlangen.
Recurrence and removal of arm July 3, 1895(?)	R	Well February, 1900	Medical and Surgical Reporter, Phila., Sept. 9, 1893; Personal communication to Dr. Buchanan.
No further data after May, 1891	R(?)	.....	Riforma med. Napoli, May 1, 1891.
Well two years later when last seen	R(?)	Too early to determine end results	The Operations of Surgery, London, 1897, p. 151; also personal letter Dec. 4, 1908.
Reported during same year	R(?)	Too early to determine end results	Bull. méd. du Nord., 1893, vol. xxxii, p. 305

TABLE I.—END RESULTS AFTER TOTAL EXCISION

No.	Operator	Date of operation	Sex Age	Condition for which operation was done	Operative results
33	J. J. Buchanan, Pittsburgh..... Buchanan's list, No. 56	Mar. 15, 1894	M. 34 yrs.	Sarcoma	Recovery
34	Madelung, Strasburg..... Buchanan's list, No. 58	Mar. 5, 1895	F. 23 yrs.	Sarcoma	Recovery
35	A. B. Johnson, New York..... Buchanan's list, No. 59	Oct. 9, 1895	M. 45 yrs.	Sarcoma	Recovery
36	J. C. Warren, Boston..... Buchanan's list. No, 60	Dec. 28, 1895	M. 14 yrs.	Sarcoma	Recovery
37	R. F. Weir, New York..... de Nancrède	1895	M. Adult	Sarcoma	Recovery
38	J. C. MacDonald, San Francisco. Buchanan's list, No 61	Jan. 31, 1896	F. 25 yrs.	Sarcoma	Recovery
39	T. K. Dalziel, Glasgow..... Buchanan's list, No. 62	Feb. 1896	M. 36 yrs.	Sarcoma	Recovery
40	J. Israel, Berlin..... de Nancrède	April 6, 1896	M. 36 yrs.	Myxochondro-sarcoma	Recovery
41	F. J. Shepherd, Montreal..... de Nancrède	June 26, 1896	F. 33 yrs.	Myeloid sarcoma	Recovery
42	G. H. Eddington, Glasgow..... Buchanan's list, Ho. 64	Dec. 27, 1896	F. 8 yrs.	Sarcoma	Recovery
43	J. E. van Iterson, Leyden ..... Buchanan's list, No. 65	Jan. 22, 1897	F. 30 yrs.	Sarcoma	Recovery
44	A. W. Mayo Robson, Leeds, now London..... Buchanan's list, No. 67	July 20, 1897	F. 20 yrs.	Sarcoma	Recovery
45	G. B. A. Moynihan, Leeds..... Buchanan's list, No. 68	Sept. 16, 1897	F. 23 yrs.	Sarcoma	Recovery
46	L. Piqué, Paris..... Buchanan's list, No. 69	Oct. 26, 1897	F. 25 yrs.	Sarcoma	Recovery
47	Wm. T. Bull..... de Nancrède	Nov., 1897	M. 52 yrs.	Fibrosarcoma	Death in a few hours from shock

OF THE SCAPULA FOR SARCOMA—*Continued*

Later history	End results	Remarks	Reference
A growth had been removed 4 months before scapula was excised	Died after 5 y.	Inoperable recurrence in upper jaw	Phila. Med. Journ., 1900, vol. vi, pp. 7–82.
Local recurrence Apr. 26; removed: local recurrence June 10; op. refused	Died in 5 m.	Disease in central end of humerus and outer portion of clavicle. Died Aug. 10, 1895	Deutsche Zeitschr. f. Chir. 1896, vol. xliii, p. 443.
Reported well at end of about 1897 by letter to author dated Dec. 5, 1908	R(?)	Too early to determine end results	New York Med. Journ., vol. lxiii, p. 389, also personal letter (1908) to author.
Operated twice during 1896 for recurrences	R(?)	Drowned over year after primary operation	Boston Med. and Surg. Journ., 1896, vol. cxxiv, p. 511. Personal letter to author, 1908.
Traced only about 2 months	R(?)	Too early to determine end results	Personal communication to author.
Well at last observation 5 years after operation	R	Permanent recovery probably certain	Occidental Med. Times, 1896, vol. x, p. 600. Also personal letter to author, Dec. 15, 1908
Well Feb. 1900 (4 yrs.) by personal letter to Dr. Buchanan	R	Permanent cure highest degree probable	Glasgow Med. Journ., 1897, vol. xlvii, p. 140
Resection of head of humerus had been done one year previously by Gruber of Charkow for enchondroma	R(?)	Too early to determine end results. Somewhat doubtful if this case should be included in this list	Berlin. klin. Wochenschr., vol. xxxiii, pp. 987–988.
Lung metastases recognized in October, 1898	Died July, 1899, a little over 3 y.	.....	Montreal Med. Journ., vol. xxv, 1896–97; personal letter to author giving final results, Dec. 9. 1908.
.....	Died in 17 m. Generalization	Generalized metastasis (see second reference)	Glasgow Med. Journ., 1897, vol. xlviii, p. 202. Brit. Med. Journ., 1901, vol. 1, pp. 954–5, April 20.
Sensory anæsthesia and deficient circulation led van Iterson to remove the arm about Jan. 29., 1897	R?	No evidence as to what end results were	Personal communication to Dr. Buchanan, who in reporting the case leads the reader to infer that there was an operative recovery.
Sarcoma of lung	Died Sept. 10, 1899, about 13 m.	.....	Personal communication to Dr. Buchanan.
Rapid recurrence at operative site in 22 days, when an operation was done	Died in 37 d.	.....	Brit. Med. Journal, 1898, vol. i, p. 1198.
In 1900 condition was reported as good	R(?)	External third of clavicle normal but removed to facilitate operation	Bullet. Soc. Anat. de Paris, vol. lxxii, 1897, p. 919. Piqué et Dartigues, Rev. de Chir., Paris, vol. xxi, pp. 437–488.
.....	Death	.....	Extract from records of New York Hospital secured by the kindness of Dr. F. W. Murray.

TABLE I.—END RESULTS AFTER TOTAL EXCISION

No.	Operator	Date of operation	Sex Age	Condition for which operation was done	Operative results
48	M. Schmidt, Cuxhaxen..... Buchanan's list, No. 70	Dec. 5, 1897	M. 57 yrs.	Sarcoma	Recovery
49	Dr. Tricomi, Rome..... de Nancrède	1899(?)	M. 47 yrs.	Myxochondrosarcoma	Recovery
50	A. Gerster, New York..... de Nancrede	July 11, 1899	M. 8 yrs.	Sarcoma	Recovery
51	C. H. Golding-Bird, London..... Buchanan's list, No. 72	Jan. 10, 1900	F. 10 yrs.	Sarcoma	Recovery
52	E. Quenu and G. Renon..... de Nancrède	July 23, 1902	M. 16 yrs.	Sarcoma	Recovery
53	Rotter, operated by Gunkel ..... de Nancrède	1903	.....	Endothelioma (Sarcoma)	Recovery
54	C. M. Stemen, Kansas City..... de Nancrède	March, 1904	M.	Sarcoma	Recovery
55	A. Nota..... de Nancrède	Mar. 12, 1904	M. 46 yrs.	Sarcoma	Recovery
56	Chas. C. Allison, Omaha..... de Nancrède	.....	.....	Sarcoma	Recovery
57	G. W. Crile, Cleveland..... de Nancrède	.....	M. 12 yrs.	Sarcoma	Recovery
58	P. Bastienelli, San Giovanni Valdarno ..... de Nancrède	Feb. 20, 1905	F. 9 yrs.	Sarcoma "Myelogenic osteosarcoma"	Recovery
59	F. J. Lutz, St. Louis..... de Nancrède	April, 1905	M. 31 yrs.	Sarcoma	Recovery
60	J. J. Buchanan, Pittsburg..... de Nancrède	July 1, 1905	F. 18 mos.	Sarcoma	Recqvery
61	C. B. G. de Nancrède, Ann Arbor de Nancrède	Feb. 1, 1906	M. 28 yrs.	Sarcoma	Recovery
62	L. A. Dunn, London..... de Nancrède	Nov. 7, 1904	M. 35 yrs.	Sarcoma	Recovery
63	M. Lejars, Paris..... de Nancrède	July 9, 1908	F. 24 yrs.	Sarcoma	Recovery

OF THE SCAPULA FOR SARCOMA—*Continued*

Later history	End results	Remarks	Reference
Local recurrence at end of one year; a metastatic growth at exit of one sciatic nerve from pelvis	Probably (?) fatal. Last trace Jan. 13, 1899	Secondary growths in axilla were removed once	Deutsche Zeitschr. für Chir., 1898–99, vol. l, p. 394.
Traced only one month after operation	R(?)	Too early to determine end results	Extirp. completa della Scapola per sarcoma. Arch. ed atti d. Soc. Ital. di Chir. 1899. Roma, 1900, vol. xiv, pp. 263–264.
No record beyond one month	R(?)	Too early to determine end results	Festschrift, Abraham Jacobi, May 6, 1900, p. 124.
No record beyond one month	R(?)	Entirely too early for any definite end results	Personal communication to Dr. Buchanan.
Record of barely 4½ months	R(?)	Too early for any definite end results	Rev. de Chirurg., Paris, vol. xxvii, pp. 421–436.
Several weeks later head of humerus removed to facilitate healing; died of "croupous pneumonia"	Died 4 m.	Was not the "croupous pneumonia" really pulmonary sarcomatosis, producing consolidation and a simulation of genuine pneumonia?	Deutsche Wochenschr. Vereins-Beilage, vol. xxix, p. 177.
None, but information inadequate	R(?)	Alive in 1908	Personal letter to author.
Last report 6 months after operation	R(?)	Too early for end results	Gior. d. R. Acad. di Med. di Torino, 4, S. vol. x, pp. 651–657.
Visceral metastasis in two years	Died soon after secondaries appeared	.....	Personal letter to author.
Early intrathoracic metastases	Died in 6 m.	.....	Personal letter to author.
Well on Dec. 15, 1908, as reported by operator to author by letter	R(?)	Tip of coracoid left to facilitate operation. Enlarged axillary gland removed nearly two years later. Was well Dec. 15, 1908	Sopra un caso di extirpas totale della scapola sinistra, Polyclinico, Roma, vol. xiv, sez. prat., pp. 97–102. Personal letter Dec. 15, 1908.
.....	R(?)	Reported well 32 months	Surgery, Gynecology and Obstet., Chicago, vol. iv, pp. 11–12. Personal letter Dec. 13, 1908.
Discharged within one week; later news, Jan. 22, 1909, well	R	Perfectly well Jan. 22, 1909	Personal letter to author. Jan. 15, 1909. Letter from father 1–22–1909. Kindly sent me by Dr. Buchanan.
Marked recurrence (inoperable) by Aug. 24, 1906; soon after "became numb from breast down with secondaries probably in the dorsal vertebræ	Died of recurrence and generalization, 4 mos. 19 days	Died July 19, 1906	Hospital Record, University of Michigan.
Reported well nearly two years after operation. In 1907(?) extensive local recurrence and death	Death in about 3 y.	.....	Brit. Med. Journ., March 26, 1908. Personal letter of Jan. 9, 1909 to author.
Latest report, 3 months	R(?)	Clavicle divided for convenience. Too early for determination of end results	Sarcome de l'omoplate gauche, ablation totale de l'omoplate. Bull. et Mém. Soc. de Chir. de Paris, N. S., vol. xxxii, pp. 802–4.

TABLE I.—END RESULTS AFTER TOTAL EXCISION

No.	Operator	Date of Operation	Sex Age	Condition for which operation was done	Operative results
64	S. McEwen, Orlando, Florida.... de Nancrède	Jan. 25, 1908	M. 26 yrs.	Endothelioma (Sarcoma)	Recovery
65	F. N. Pryanishnikov..... de Nancrède	1908	M. 7 yrs.	Sarcoma	Recovery

TABLE II.—CASES WHERE MORE THAN THE SCAPULA WAS INVOLVED BEING REMOVED AT ONE SITTING WITH PRESERVATION

No.	Operator	Date of Operation	Sex Age	Condition for which operation was done	Operative recovery
1	Von Langenbeck, Berlin..... Buchanan's list, Case 1	May 22, 1855	M. 12 yrs.	"Malignant growth" (Sarcoma?)	Recovery
2	M. Michel, Strasburg..... Buchanan's list, Case 12	Sept. 20, 1868	M. 50 yrs.	Cyst of bone, almost certainly benign	Recovery
3	J. Spence, Edinburgh..... de Nancrède	Dec. 25, 1871	M. 68 yrs.	Tumor	None
4	G. Poinsot, Bordeaux..... Buchanan's list, No. 31	Sept. 6, 1884	M. 52 yrs.	Sarcoma	Death
5	A. MacCormac, Sidney..... Buchanan's list, No. 38	April, 1887	M. 56 yrs.	Sarcoma, primary in muscle	Recovery
6	C. H. Golding-Bird, London..... Buchanan's list, No. 52	Mar. 28, 1893	F. 14 yrs.	Sarcoma	.....
7	P. Berger, Paris..... Buchanan's list, No. 66	June 2, 1897	F. 21 yrs.	Sarcoma	Recovery
8	C. M. Stemen, Kansas City..... de Nancrède	Nov. 14, 1899	M. 51 yrs.	Sarcoma	Recovery
9	M. Poisson..... de Nancrède	1905	M. 30 yrs.	Sarcoma	Recovery

* I desire to express my indebtedness to Dr. C. A. Pfender, of Washington, D. C., and to Dr. M Kollig, of Ann Arbor, Mich.

OF THE SCAPULA FOR SARCOMA—*Continued*

Later history	End results	Remarks	Reference
Last accessible report less than seven months after operation	R(?)	Too early to determine end results	Journal of the Amer. Med. Association, vol. li, Aug. 29, p. 757.
Inoperable metastases in less than 2 months on head	Died. Exact time not given	Resection of the head of the humerus and portion of the clavicle "for the purpose of securing a better joint," but they were apparently uninvolved by the neoplasm	Khirurgia, Mosk., vol. xxiii, pp. 141–148.

IN THE NEOPLASM, ALL OF THE SUPPOSEDLY DISEASED TISSUES OF THE REMAINDER OF THE UPPER EXTREMITY.

Later history	End results	Remarks	Reference
Recurrence in 109 days	Died in 3½ m.	Three inches of clavicle removed because imbedded and involved in the growth	Fock, Deutsche Klinic, 1855, No. 38, p. 422.
No recurrence	Recovery lasting over 5 y.	Microscopic description indicates probably a relatively benign myeloid growth	Levrey, Resection complète du Scapulum, 1869; also Case 3 of Heldrich, Totale Resectionen der Scapula, Diss. 52 p., Muenchen; Also Gaz. Hebdom. de méd., Paris, vol. ii, pp. 432–435.
Rec.?	.....	Clavicle divided for convenience. Clinical diagnosis; malignant. Course pursued and microscopic appearances left Mr. Spence in doubt.	Lect. on Surg., 3d ed., vol. i, p. 963 et seq.
No time for recurrence	Died in 2 d.	Outer portion of clavicle involved and removed; head of humerus excised for better shaped shoulder. "Gangrene gazeuse"	Rev. de Chir., Paris, 1885, vol. v., p. 201.
Operation for recidives June and December 1889; patient well 1898	R	Acromium sawn across at base and left. Growth primary in serratus magnus muscle, later involving scapula, the recidives, required removal of portions of the external intercostals; cautery freely employed	Australasian Med. Gaz., 1898, vol. xvii, p. 295.
Recurrence in wound and axilla	Died in 1 y. 5 d.	A part of the clavicle was involved in the disease and removed	Lancet, London, 1893, vol. i, p. 1066; also personal communication to Dr. Buchanan.
Recurrence of growth excised early in 1899	R(?)	Latest report March 1900; too early for definite end results. Primary growth was in the trapezius, secondary in the scapula and clavicle, a portion of the latter being removed	Bull. et Mém. Soc. Chir. de Paris, 1897, vol. xxiii, p. 571. Later personal letter to Buchanan.
Removal of one half of clavicle because involved by the neoplasm	Died 19 hours after operation	.....	Personal letter to author.
No definite after history	R(?)	Curettage of a neoplastic area in the head of the humerus	Ablation totale d'omoplate. Gaz. Méd. de Nantes, 2. S. vol. xxiii, pp. 114–115.

successes (?) the cases of the following patients whose records are complete, who died from the operation or its results, or from either recidives or metastases, or where the data were too incomplete to determine the "end results."

Case number.	Results.
1.	Died in two months.
2.	Died in six months.
3.	Died in ten months.
4.	Apparent recovery, already referred to.
5.	Died in ten months.
6.	Died in six months.
7.	Died on fifth day.
8.	Died in five months.
9.	No data after two years.
10.	Died in six months.
11.	Died in four and one-half months.
12.	Died in six months.
13.	Died, no date.
14.	Observed three months.
15.	Observed few weeks.
16.	Probable cure.
17.	Died under one year.
18.	Died in a few months.
19.	Died in thirty-six hours.
20.	Died in one hour.
21.	Died in eighteen months.
22.	Died on same day.
23.	Died on fourteenth day.
24.	Died in fifteen months.
25.	Died in three and one-half months.
26.	Died in fourteen months.
27.	Died in one year.
28.	Died in ten weeks.
29.	(Phelps) probably cured.
30.	Observed only a few months.
31.	Observed only two years.
32.	Died under one year.
33.	Died in over five years.
34.	Died in five months.
35.	Observed only about two years.
36.	Drowned about four years after last operation.
37.	Traced only about two months.
38.	Died from recurrence after sixth year.
39.	Probable cure.
40.	Only a few months.
41.	Died in three years.
42.	Died in seventeen months.

Case number. Results.

43. No later history.
44. Died in thirteen months.
45. Died in thirty-seven days.
46. Probable cure but too early for reliable results.
47. Died in probably two years.
48. Only traced one month.
49. Only traced one month.
50. No record beyond one month.
51. Record only four and one-half months.
52. Died in about four months.
53. Possible cure.
54. Record only six months.
55. Died in over two years.
56. Died in six months.
57. Nearly three years, possible cure.
58. Observed thirty-two months.
59. Observed over three and one-half years.
60. Observed three years and seven months, then well.
61. Died in five months.
62. Died in three years.
63. Observed only three months.
64. Observed less than seven months.
65. Died from early inoperable cranial growths within less than two months.

Cases 48, 49, 50, 51, 53, 57, 58, 63, 18 and 63 have no reliable record as to "end results," having data lasting perhaps only one week, one month, four and a half, six months, up to and at most thirty-two months in one case. In the light of the evidence of recurrence, as shown by the records of other cases already quoted, who can doubt that the "end results" if known, would be as bad as those already finally determined, *i.e.*, usually death, possibly one or two recoveries.

Putting the facts in another way, out of 65 cases, 26 were dead in less than one year, 3 were dead inside of eighteen months, 2 survived two years, 2 lived for three years and 1 for five years before succumbing. Thirty-five then died inside of two years—over one-half.

Of the 9 cases included in my second table where disease had invaded the surrounding tissues requiring their removal, and including two cases where the diagnosis was doubtful, the showing is not materially better.

Case No. 1 died in three and one-half months; Case No. 2 was well over five years but the malignancy of the growth is much in doubt; No. 4 died in two days from wound infection; No. 5 where the growth was secondary in the scapula was well nine years later after repeated operations; No. 6 died in one year and five days; No. 7 was only observed about one year; No. 8 died in nineteen hours; while concerning Nos. 3 and 9 there is no definite history.

To what conclusions does this sorry showing drive us? That except under peculiarly advantageous conditions, we cannot hope for much prolongation of life, and still more rarely for a permanent cure. This latter can only be secured by a very early operation—almost as soon as the growth is diagnosed. Unfortunately, in certain instances, even the earliest possible intervention will prove unavailing, probably owing to the unusually favorable relations of the minute blood-vessels of the growth to the neoplastic cells, presenting facilities for their embolic dissemination.

The probabilities as to operative death; whether recoveries are more common than in the past; the probabilities of local or general recurrence; whether these are early or late; to what late death is due when operative recovery occurs; and can excision of the scapula be considered a curative operation, are best and most fully answered by a study of my tables,—nevertheless, I shall dwell chiefly upon some of these points. One question as to whether life is prolonged when death results from recidives or generalization cannot be answered, as there are no data securable as to the natural history of unoperated sarcomata of the scapula.

Study of the literature reveals other data than those which I can now give, showing how commonly recurrence in loco takes place, and how probable it is that the recidives provide the foci whence generalization occurs, the primary growth having been removed before metastases had taken place; hence, if local recurrence is preventable by earlier operation, a certain number of fatal cases of visceral involvement might be avoided. At once the question suggests itself, might not an

interscapulo-thoracic amputation instead of an excision of the scapula render possible a much wider extirpation of the tissues in which recidives occur, and thus lead to a greater number of permanent recoveries? The evidence on this point I have not attempted to secure but would urge that this investigation be made in the near future by some one of the Fellows.

The commonly accepted reasons for the early metastases by the vascular system are too well known to need mention, but I believe clinically, too much stress is unwittingly placed upon one fact and too little upon another, unconsciously creating a tendency to fall into a most serious error. Because lymph-node infection is a not uncommon possibility in sarcoma of bone, in the absence of any such complication, when no obvious visceral metastases are detectable, we too often ignore the probability of the presence of innumerable minute metastatic deposits in the lungs and other organs, which from their small size, their number and uniform dispersion throughout the viscera, defy detection by the most expert diagnostician *at the time of operation,* too often to demonstrate their fatal presence after all the primary focus has been thoroughly removed, and where no recidives appear in situ, whence the generalization could have occurred.

While my tables cannot be made to show in a definite way the propriety of these statements, the extended histories of many of these cases fully warrant my assertions.

Although these cases do not appear to bear upon the question of the lessened operative mortality of excision of the scapula, operative removal of the scapula for other conditions as well as the more recent cases included in my tables, show that total excision of the scapula is somewhat less dangerous than formerly. Possibly some patients who died in the past of shock and hemorrhage, had they survived would have shown additional cures, so that the probabilities of slightly improved "end results" may be anticipated. If this operation is performed for unquestionably benign growths, it is entirely proper and should prove increasingly successful. Percentages, as be-

fore stated, are misleading rather than informing, hence none such will be given.

Certainly metastases and recidives are common, if indeed metastases have not already occurred before operation, but have been overlooked.

With very few exceptions, all complete histories sooner or later show that death resulted from local recurrences or generalization throughout the economy.

Although I am unwilling to take an extreme position, if the positive diagnosis of malignant disease can be made, I shall, I think in the future, recommend early intercostohumeral amputation, until this procedure is also proved to be inferior, or no better, in the "end results" than complete excision of the scapula alone, and I shall set my face absolutely against any partial resections of the shoulder-blade for malignant disease.

No one can deny that retention of the remainder of the upper extremity is desirable, and that it is always of some utility, while in many the ability to use the arm is surprisingly good. Nevertheless, life should be considered first, utility last.

None would be more pleased than I to have my gloomy forecasts disproved, but I cannot shut my eyes to what I have learned from a study of the literature of the subject. The outcome of my investigations was a complete surprise to me, as I anticipated a far different result.

In conclusion, permit me to ask a careful consideration of my tables, prepared only after the consumption of a vast amount of time and study and which have led to such unforeseen conclusions. I would also insist upon the propriety of the application of similar methods to the study of some of our accepted plans of treating other diseases. This is not my first experience of the disillusionizing effects of a study of "end results." A number of years ago I read a paper in Chicago, where my own experience and that of others to which I had access, demonstrated *by the end results,* the almost certainty of ultimate failure to cure focal and Jacksonian epilepsies by the excision of the discharging cerebral lesions.

THE OLD, AND THE BEGINNING OF THE NEW, IN SURGERY.*

BY J. EWING MEARS, M.D.,

OF PHILADELPHIA.

IT has happened to the writer to have lived in one of the World's periods of greatest activity and progress. It may be questioned whether the last half of the Nineteenth Century cannot claim the maximum of development in those conditions which have contributed to the improvement of man's stay on earth. In considering these conditions, and the influence exerted by them, it must not be forgotten that the foundation upon which they are builded and upon which they rest, took origin at the very beginning of man's existence—at the dawn of creation,—and the structure of knowledge has grown progressively through the contributions which have been made in successive periods of time, influenced by the conditions of life which have constituted their environment. This, it may be said, has been eminently true in the development and growth of surgery—at one time the legitimate part of the barber's art, and emancipated only from this ignoble association when the genius of those who were its disciples gave to it its proper place as a part of the science of medicine, through the ingrafting of the principles of that science which were essential to its development and growth. In the successive ages of the World's history the value of life has been measured by the increase in knowledge of the means of its preservation, and all efforts have been directed to those ends, until in this day the prevention of disease, through the prevention of the causes which produce it, has become the ideal object of the labors of the disciples of the art of healing.

In view of the limit the writer has fixed for the discussion of the subject expressed in the rather comprehensive title of

* Read by title before the American Surgical Association, June 4, 1909.

his paper, he is moved to state that it will concern chiefly his own experience, which covers nearly the last half of the last century. In that period of time two of the most important and controlling contributions to surgery have been made—the general introduction of the use of ether as a anæsthetic agent in major surgical operations and the method of antisepsis in the treatment of wounds.

With regard to the first, it has occurred to him to witness operations upon patients who had been placed in a state of insensibility, more or less complete, by large draughts of alcoholic stimulants or by the administration of opiates in unusual quantities. Firmly bound to the table the patient has been unable to offer successful resistance and the operative procedure was conducted to the end, despite the agonizing cries of pain and suffering. These conditions of necessity limited surgical interference to cases of absolute emergency and those which involved the extremities, as a rule, and which were the result of accidental injuries. Great as was this boon, general anæsthesia, to suffering humanity, the agent employed possessed certain objections, the chief one being that of the nausea following its use, in many cases, and the effort has been continuous to obtain a substitute freed from this condition. Up to this time many agents have been added to the list of anæsthetics, local and general; but attached to each there has been found to exist some element, either of danger or unsatisfactory efficiency, and the search, through observation, practical experience, and laboratory experimentation continues in order to find the ideal substance—one capable of producing complete insensibility to pain without the loss of consciousness. The nearest approach to the accomplishment of this desirable condition would seem to have been found in the use of stovine by lumbar puncture; but this method is not free from elements of danger, which, in reported cases, have led to fatal results.

Taking a fundamental part in the development and growth of surgery in the time set apart, were the methods of instruction in vogue in the beginning. The sessions of the medical

colleges were short, at most, not more than three and a half to four months in each year, and the student, while he was expected to enter at the beginning of the course, was permitted to begin his collegiate studies after a large part of the session had passed. A requirement for entrance and for the privilege of appearing for the examination for the degree of Doctor in Medicine at the termination of the two years' course of instruction, was a presumed year's study and apprenticeship in the office of a practitioner, whose qualifications as an instructor were quite an unknown quantity. No conditions were imposed as to preliminary education. Graduation from a school of high grade was rare, and still rarer was the possession of the degree of Bachelor of Arts by the candidate for admission. The methods of instruction were didactic, and the student sitting on the benches for two courses in succession heard the lectures of the first course repeated, without, in most instances, addition or emendation. When the learned professor read his lecture from manuscript pages, it has happened, to the knowledge of the writer, that the paper was yellow with age and the text was as ancient as the paper. The dissecting room was the only laboratory, and the work done therein was largely of a perfunctory and defective character, concluded without any test by examination in the presence of the dissected specimens, of the knowledge gained by the student. The fee for instruction paid by the student was outside of the college ticket and was the emolument of the demonstrator, and did not reduce the sometimes large receipts of the professors, who received all of the income of the college, paid the expenses of maintenance and divided the remaining balance, sometimes giving to each from five to eight thousand dollars in the year.

The large sum obtained by the professors each year was increased by the sale of the text-books, written by them, copies of which each student was expected to buy—if his financial resources permitted such expenditure. As the lectures of the professors were embodied in these books it was to the advantage of the student to possess them, and the study of them

assisted in the work of preparation for the final examination. In a way it may be said that the text-books on different medical subjects written by the professors who taught the branches, were more useful to the student than those written to-day by a number of authors and edited by one or two. As a student, in the text-book of the teacher he receives instruction which is individual, and not the opinions of many who may treat the subjects in very different ways. As a graduate and a practitioner the text-book of many authors may possess for him positive advantages and assist him in his work.

Anatomical material was expensive, and, in the absence of legal provisions by the State, sometimes difficult to obtain by methods short of "Burking," with the suspicion even that this method was resorted to. The surgical laboratory did not exist, and the student, as a rule, received his degree, which declared him qualified to practice surgery without having received any practical instruction in the application of surgical dressings or in the performance of surgical operations of either minor or major character upon the cadaver. The student who felt the necessity of possessing practical knowledge on this subject was compelled to obtain a cadaver at his own expense and pay a private instructor for the instruction given.

In the days spoken of, at a later period, the eminent teacher of surgery in Jefferson Medical College, Professor Samuel D. Gross, organized, as a part of the instruction of his chair, a surgical laboratory, and the writer was appointed to take charge of the department of surgical dressings, sharing the duties with a colleague who gave instruction in operative surgery. Later, the entire instruction in the laboratory came under the writer's care and the student received instruction in the laboratory, which was made compulsory, without extra fee. This condition the writer earnestly advocated, feeling that every student receiving the collegiate degree should be required to receive instruction of this character, and without extra cost. It is believed that the surgical laboratory, thus organized by Professor Gross, was the first established in the

medical colleges of this country. The branches of medicine which were included in the curriculum were the traditional seven, Anatomy, Physiology, Materia Medica and Chemistry, Principles and Practice of Medicine, Principles and Practice of Surgery, and Obstetrics. With the exception of anatomy the fundamental branches were taught only by lecture and laboratories, for experimental and practical work in these branches were absent. Students who were ambitious to gain practical knowledge in materia medica, had the opportunity in certain apothecary shops, where they were instructed in the art of making pills, powders and certain simple mixtures. In medicine, clinical instruction was given by the professors in turn, those occupying the chairs of anatomy and surgery giving clinical instruction in surgery in the divided halves of the term. Clinical material in medicine in the college clinics was limited entirely to walking cases illustrating chronic affections, as a rule of the stomach, not extending in nomenclature beyond dyspepsia or what was vaguely designated as chronic gastritis. The diagnosis, in each case, was most frequently, if not always, made without physical examination and based upon the very vague and non-intelligent information given by the patient. The treatment was eminently empirical: a condition of inflammation being assumed as the diagnosis, counter-irritation to the extent of blistering was advised, and enforced over the epigastric region, or, as more intelligently conveyed to the patient, over the pit of the stomach. When torpor of the liver was the suspected diagnosis, remedies which would administer a fillip to the lining membrane of the intestine were regarded as indicated in order to invite and stimulate hepatic activity. There were no obstetrical clinics as such. Gynæcology was taught by lectures, the use of the speculum was demonstrated upon models or the cadaver; physical examinations were not permitted to be made before the class by the teacher, and the members of the class were not permitted to make, even under the guidance of the instructor, in the clinical room, such examinations. The solid stick of silver nitrate, more commonly

designated lunar caustic, was the agent universally applied for morbid affections of the cervix uteri, and displacements were most frequently unsuccessfully relieved by the use of very varied and uncomfortable mechanical appliances. Believing that students in medicine should have practical instruction in the methods of making digital examinations, the writer at one time conducting the gynæcological clinic, arranged to give instruction in this branch in the retiring room of the clinic to the class, in sections. The instruction was prohibited by the controlling powers of the institution as not conforming to the rules, which protected the female non-paying patient from usage not agreeable to her sense of modesty. Instruction in practical obstetrics was obtained by students who felt its necessity, on the payment of a fee, in lying-in-homes. When sufficiently instructed in the institution they were permitted under the guidance of a practicing physician to take charge of cases in the homes of non-paying patients. At an earlier date somewhat, than that of which we write, the writer has been told that, in the then frontier West, the act of parturition was accomplished while the wife was held on the lap of the husband, a limb each confided to the care of sympathizing women neighbors, whilst the physician sat on a stool between the two. It can be readily understood that this position was not one of comfort to any who were required to take part in the procedure which, in the case of primiparæ was likely to be of a prolonged character.

Clinical surgery was taught in the college amphitheatre, and, as well as clinical medicine, in certain hospitals which had lecture rooms in the buildings. In the college amphitheatre the instruction was given by the professor of surgery, or, if a practicing surgeon, by the professor of anatomy. In some instances, one or two rooms in the college building not very remote from the odors and pathologic conditions of the dissecting room were assigned for the reception of patients who had been submitted to major operations in the clinic. Bloodletting for inflammatory affections was practiced and the writer, while on duty in the surgical clinic was directed by

the professor on one occasion to bleed a patient suffering from acute iritis. Inquiring as to the number of ounces which should be let, the answer was as follows: "Ounces! Bleed him, young man, until he falls over," and the orders were strictly obeyed, with the happy result of prompt relief of the phlogistic conditions. In the hospitals the students were not permitted to "walk the wards,"—the closest contact they had with the patients was from the benches of the amphitheatre, large enough, in some cases, to seat six hundred students.

Associated with the subject of the conduct of medical colleges, in the day of which we write, it is interesting to consider their method of organization. In some States the Legislatures granted charters to medical colleges which were parts of a sweeping franchise to construct a railroad and, possibly, one or two other enterprises of commercial character. These charters came into the possession usually of members of the medical profession with political proclivities, who sold them to other members of the profession ambitious to acquire the title of professors. Some of these colleges, thus organized, were undeniably fraudulent in character and conduct,—endowed, under the charter with colossal powers and privileges they conferred degrees of all kinds from A.B. and M.D. to LL.D. and D.C.L., in the majority of cases "in absentia," and for sums of money varying in amount according to the financial ability of the intending purchaser. The conferring of these degrees was not limited to this country, but extended quite over the World. In Great Britain and the continent of Europe the business became a subject of international interference, and happily, for the good repute of the medical profession of this country, it was stopped. In marked contrast the medical colleges of to-day, with possibly a few exceptions, can claim a greatly improved condition of excellence in the requirement for entrance, one, the Harvard Medical School, exacting the degree of Bachelor of Arts,—in the extension of the sessions,—expansion of the courses of instruction—organization and conduct of the laboratory systems, and all methods which contribute to the complete education of candidates seeking admission into the medical profession.

General hospitals, even in the larger cities of the country were few in number, limited to one or two at most. Among those most closely associated with clinical teaching and venerable in years of existence were the Massachusetts General Hospital in the city of Boston and the Pennsylvania Hospital in the city of Philadelphia, founded by William Penn. The clinical amphitheatre in this hospital was unique in character, having been constructed in what may be called the cupola of the main building, in a space so restricted that the students sat on benches almost overhanging in position, and looked quite directly down upon the teacher and patient.

In the days of which we write the operations performed in the clinics were usually in the form of amputations and the removal of external growths. Operations upon the cavities of the body were limited to the cranial, and did not pass beyond the use of the trephine in cases of depressed fracture. Paracentesis of the chest and abdominal cavities was performed for dropsical effusions. Thoracentesis, with rib resection, was not practiced, and although McDowell had opened the gateway into the abdominal cavity through his operation for the removal of ovarian tumors, this operation was rarely performed, and then not in the public clinics. The writer recalls an interesting experience which came to him on the occasion of a visit to one of the hospitals connected with the teaching in the University of Edinburgh, when a distinguished ovariotomist was required by the authorities of the University to perform the operation of ovariotomy in the public clinic. He protested that the conditions surrounding operations in a public clinic were hostile to any operation which involved the opening of the abdominal cavity. Yielding, however, to the official mandate, he did the operation, which fortunately happened to be of a very simple character, and when it was completed, remarked to the class of students: "Well, you didn't see anything, did you?" Cæsarean section had been performed in a few instances, and Dr. John S. Bobbs, of Indianapolis, Indiana, had performed the first operation of cholecystotomy.

In private practice surgical operations were performed in

the homes of the patients, in bed rooms and in living rooms, without any special preparations as to cleanliness. On one occasion, when the writer assisted in an operation of abdominal section—ovariotomy—the operating room was in the top story of a tenement house, under the roof, in a narrow alley-way. During the operative procedure a sudden and heavy thunder-storm occurred with a deluge of rain, and the water poured through openings in the ancient and perforated roof, one stream being so directed that, before the assistants could interfere, it entered the abdominal cavity through the large incision which had been made to effect removal of the adherent tumor. Efforts were made quickly to place the operating table, the usual kitchen table, in a place better protected from such irrigation methods. It was felt, however, by those present that the storm water was as clean, if not cleaner than that which was used from the somewhat battered and discolored tin hand-basin. The operating table in the homes was usually the kitchen or double-leafed dinner table, which were firmer than the bedstead or lounge which were sometimes brought into service. In one case, the writer excised the greater part of the upper jaw in a patient, who being addicted to the excessive use of alcoholic stimulants, became frenzied during the ether administration, and, flinging aside the assistants, men and women of the household, threw himself upon the floor. Extra help was summoned, which sitting upon the patient in his prostrate position, controlled him while the operation was completed—patient, surgeon, and assistants being well bespattered with blood. In another case in which the writer was called in consultation, the patient, a burly chief of police of the town and an alcoholic subject, during the process of ether inhalation sprang from the lounge in the stage of stimulation, went to a closet, and seizing a loaded revolver stalked about the room in a very menacing manner. The family physician, a brave and resourceful man, taking advantage of a convenient opportunity, leapt upon his back, pinioned his arms, and in this position directed his movements skillfully to the open door, the frightened assistants meanwhile emerging

from safe places of refuge which had been sought at the time of the impending danger. In this case, the operation was completed without the further administration of the anæsthetic agent.

Associated with these conditions of improvised operating arenas was the indifference manifested by the surgeon and his assistants with regard to the state of cleanliness of the operating instruments, of the sponges and other materials used in the wound-cleansing during the operation, and in the subsequent dressings which were applied. The instruments were not many in number, made with bone handles, white or black in color, often with dull cutting edge and kept either in an operating case or placed loosely in a bag of convenient size. The sponges, which were universally employed in the wound cleansing, were those gathered from the sea and found in the apothecary shops. Those known as surgical sponges were usually of finer texture than the ordinary bathing sponges. Frequently they were charged with calcareous particles and prickles that were almost microscopic which proved to be irritating to the wound surfaces as well as to the fingers of the assistants using them. The sponges, if of good quality, were very enduring and did duty for a long period of time. One distinguished ovariotomist was accustomed to replenish his stock of *three* sponges at the beginning of each year. He never used more than that number, and they were always accounted for after an abdominal section, in order to prevent the untoward accident of permitting one to remain enclosed in the cavity when the operation had been completed, an accident which has happened in several recorded and some unrecorded cases. It is known to the writer that after operations the sponges have been used to remove blood from the table and even from the carpet or floor. They were cleansed after operations either in the basins which had been used to contain the hot and cold water, which alone was applied to the wounded surfaces, or under the hydrant in the back yard, if the patient lived in the home of the poorer class. They were placed uncovered in the bag containing the instruments in

which was also frequently concealed the morbid specimen which had been removed by operation. The basins containing the water used during the operation came either from the kitchen or bed-room, and the dressings and bandages were often obtained by tearing them from unlaundered sheets or muslin or linen underwear.

The garb of the surgeon was sometimes a rubber apron of large dimensions or a coat known as a generally used linen duster, on the sleeve or body of which the blood-clotted knife was frequently wiped. The assistants performed the duties assigned to them in their shirt sleeves divested of coat and vest. In the absence of proper conveniences the hands were not washed. In cases of malignant character or those accompanied by foul discharges they were anointed with olive oil or lard. The effort was constantly made to protect the surgeon and his assistants from dangers coming from the patient, not the patient from dangers coming from those taking part in the operation.

The writer has been told of an instance in which a very prominent ovariotomist of the middle West, who suffered from vesical calculus, accompanied by a severe cystitis, stopped twice during the performance of an operation, took the soft catheter from the place beneath the sweat-band of his hat, lubricated it with spittle, evacuated his bladder and continued the operation without washing his hands. Of another surgeon who, during an operation for amputation of the thigh, overheard the casual remark of one who was present that the patient looked as if he had "phthisis." He had made the anterior flap, but put the amputating knife upon the table and proceeded to make a physical examination of the patient's chest, one of his assistants holding his thumbs over the femoral artery with some anxiety during a somewhat prolonged procedure of auscultation and percussion.

The after care of patients in the hospitals was a duty undertaken, as a rule, by convalescent patients, or in some cases, by men and women who served as nurses for a slight compensation. As can be conceived, by these methods, patients

suffered from ignorant and at times cruel treatment. The writer recalls an instance which happened during his term of service as interne in the hospital of a large eleemosynary institution, in which the nurses were taken from among the number of pauper inmates, some of whom belonged to the criminal class. On one occasion when a wound was being dressed, the nurse placed his foot, encased in a dirty boot, upon the bed, and spat tobacco juice from his foul mouth directly into the water contained in the dirty basin which was used in the effort at the supposed cleansing of the wound. This act was regarded as the limit of endurance, even in those nonaseptic days, and the offender was promptly relieved of his duties as nurse and sent to the kennels of the out-ward department. In the homes the care of patients after operation was assigned to the female members of the family or friends who volunteered their services. Under these conditions the patients received kind treatment and good care, sometimes endangered by the emotions which sprung from the warm heart of the attendant, whose conception of sick-room discipline was thereby influenced.

In no way was the absence of regard for cleanliness more forcibly illustrated than in the use of the catheter in hospital and in private practice. In the former the unwashed instrument was frequently used after lubrication with olive oil or simple ointment contained in vessels which had been in use for long periods of time, affording in this way easy access into the bladder of septic germs. In private practice the metal instrument carried in the pocket case, and lubricated in the home with lard or butter, was used. When the soft or rubber instrument was introduced the walking patient was instructed how to use it, and carried it conveniently coiled up beneath the sweat-band of his high hat, and when used in inconvenient places, lubricated it with spittle.

Of the dressings most frequently used after operations to combat inflammatory conditions the emollient poultice was most popular. It was made of stale bread crumbs with water or milk, but most generally of flax-seed meal. The directions

given by the learned professor with regard to the preparation of this last poultice were very specific in character, and unless these were strictly followed failure was predicted. The test given of the proper consistency was to be found in the adhesion of the mass to the side wall or ceiling of the room when projected against these parts of the room structure. At the final examination of the candidate for the degree given by the college, his ability to practice surgery was determined, to a certain extent, by his knowledge, in minute detail, of the poultice preparation. In the lectures and text-books poultices were classified according to the effect to be accomplished: as emollient, astringent, stimulating, fermenting, rubefacient, narcotic, etc. Suppuration in the wound followed the use of the emollient poultice and the discharge of pus was, as a rule, very copious. The wound condition was determined by the character of the pus,—if laudable, favorable; if sanguinolent or ichorous, unfavorable. Among other forms of dressings the writer recalls a case of amputation at the hip joint in which the stump was kept bathed with laudanum (tinctura opii) and without any manifestation of the toxic effect of the agent used.

During the Civil War the discipline which was enforced in the camp and on the march was carried, in some measure, into the management of the General Hospitals of the Service, with favorable results as to conditions of cleanliness in operation and in wound treatment. In this respect, however, the results were influenced to a large extent by the qualifications of the surgeon in charge, or of the inspector who made his tours of inspection. Notwithstanding the precautions taken and those which were born of the knowledge of the time, the mortality was very great. Gangrene, designated hospital gangrene, was of a most virulent type and resisted all known methods of prevention or treatment. The ignorance with regard to the influence of germ infection led to the tolerance of conditions most productive of disease dissemination, and thousands of lives paid the penalty for what was then regarded as a state of inevitable ignorance. The lessons, however, were

not lost, and the faithful, earnest surgeons of the day, groping their way through the darkness sought the light which was to be reached in not many years to come. The General Hospitals were located in cities and, where possible, in the suburban parts, in the search for better air and surroundings. In some instances these were large wooden structures constructed upon the pavilion system, which gave both light and air. They contained usually a large number of both medical and surgical cases, and the physicians and surgeons in attendance were largely chosen from those practicing in the cities, with some officers of the regular service. In the emergency, large buildings in the cities, which had been constructed for factory or mill purposes, were taken and converted to hospital use. That these should fail to give the best results, by reason of former use and character of construction, was to be expected, but the needs of the Service demanded such provision for the sick and wounded, who in the large variety of diseases and wounds from which they suffered furnished a great school of instruction to the intelligent and observant physician. Chloroform, unmixed with other agents, was the anæsthetic largely, if not altogether, used in operation, and many lives, it was reported, were sacrificed through its careless administration. The need of medical men in large numbers to supply the demands of the Service led to the appointment of many not fully qualified, but as a rule the surgeon, especially in the emergency of Service in the field hospital following great general engagements, was found to be equal to the duty imposed. The writer recalls two instances in which wounded soldiers were brought to a military hospital in which he was the temporary acting executive officer, with extremities suffering from compound fractures, the result of shell wounds; in one the limbs were encased in an excellent supporting dressing made from the bark of a tree, and in the other, rails, taken from the ordinary rail fence of the country did good service in affording support and permitting comfortable transportation.

The large number of pathologic specimens obtained and

preserved, with full histories of each, laid the foundation for the valuable collection in the Army Medical Museum, the development of which, with the Surgeon-General's Library, was so successfully promoted through the work of our distinguished Honorary Fellow, John S. Billings, at one time the efficient surgeon in charge. In the ending days of the War the writer met in London, Sir James Ferguson, the celebrated English surgeon and teacher who remarked, in commenting upon the work done by the medical profession of our country in that heroic struggle, that the members had done splendid work and deserved great credit for what they had accomplished. No war, certainly none of modern times has offered such opportunities for the study of diseases and surgical conditions incidental to the life of the soldier in field and camp and in the deadly conflict of arms. The arm of precision today projects a missile the purpose of which is to disable, to put the soldier out of service—in the time of which we write its duty was to destroy life, discharging, as it did, the large death-dealing minie ball. Following the experience gained in the Civil War, surgical endeavor was greatly stimulated and methods were improved. In this period also, and later, there appeared operations which may be designated, as in a way, fashionable. The organs of generation in the female and near-by parts presented a large field for exploitation, and operations were performed for the relief of supposed functional disturbances, correlated with supposed grave constitutional conditions. Freed from the difficulties and dangers of organic changes the hand of the tyro and empiric found free play. Condemned by professional opinion and judgment these operations have been stricken from the list of those necessary to be performed, or justifiable in purpose. Unfortunately for the good repute of surgical science, this glamour of professional notoriety, promoted by the eager desire of commercial success, has been in a measure transmitted, even to this day, and confiding patients have been, shall we say, the victims of the untoward results of surgical procedure not necessary for the relief of supposed morbid

conditions. But this is passing,—the stern verdict which true science renders when sitting in judgment on the work of those who assume to be its disciples, consigns to merited punishment those who violate its principles and degrade the standard of its code of ethics.

The operations, claiming in these days to be the most important, and involving as well danger by reason of their character and magnitude, were amputations at the hip joint, ligature of large arterial trunks, and the removal of ovarian tumors by abdominal section. In the former operation the percentages of success were fairly good. The text-books of the day gave prominent position to a surgeon of local repute who had three successful cases—in succession. A mortality not exceeding 32 per cent. was regarded as most favorable in operations of ovariotomy,—and this percentage prevailed when the cases were those of non-adherent monocysts. In multi-locular cysts with parietal and visceral adhesions, the percentage of mortality was greatly increased, exceeding often 50 per cent. The writer, as the assistant of the distinguished ovariotomist, Dr. Washington L. Atlee, contributed a chapter on the "Pathology of Ovarian Tumors" to his book, and in this he announced what he regarded as a discovery of some interest, to the effect that the pathological conditions which followed operative interference had an important relation to the length of the incision made in the linea alba in the abdominal section. The small incision was only possible in simple monocysts in which, when the fluid contents were being drawn off, the flexible walls of the cyst could be drawn into the opening, and effectually sealed the abdominal cavity, thus preventing the ingress of the air, and with it the then unknown and unrecognized myriads of organisms with which it was charged. The knowledge of the day did not permit of an understanding of the relation of cause and effect involved in these conditions. Experience had demonstrated that the air in coming in contact with the surfaces of a wound or the lining membrane of a closed or serous cavity, was harmful, but in what manner it acted was not known. It re-

mained for Lord Lister to solve the problem and to devise a system through which these organisms were destroyed and the process of putrefaction in wounds prevented.

In the decade included between the years 1865–1875, the dawn of a new era appeared in surgery: the beginning of the new—the new built upon the work of the old, surcharged as it was, of very necessity, with ignorance born of the absence of knowledge beyond the discern of man. The wound conditions with which the observant surgeon had to deal led in time to the recognition of the fact that they were not normal, that there were no conditions in the tissues themselves which should generate them, and that their causes must be sought for outside. The experimental researches of Pasteur determined the causes of putrefaction, and it remained for the reflective mind of Lister to associate these causes with the abnormal conditions observed in wounds. The result of his painstaking and laborious effort was the creation of a system which prevented the introduction of putrefactive influences into wounds, the destruction of the organisms of putrefaction, everywhere existent, before or after their admittance into a wound cavity. This was the beginning of antiseptic surgery, a monumental contribution to the science of which Lister was an illustrious disciple and one which has influenced its development as no other which has ever been made. In the gradual process of refinement from the crude but efficient antagonistic measures and combative dressings to the perfected system of to-day, antiseptic surgery has been deposed, and aseptic surgery rules in its stead. The foul kitchen basin has given place to the porcelain lined tray,—the sea-born sponge, with its myriad cells charged with deadly organisms, has been replaced by the cleanly, once-used gauze sponge,—the bone and wooden handled knife by the one-piece metal instrument—the kitchen table and sitting-room lounge by the metal and glass structure with its convenient mechanism. The bed-room and sitting-room in the home, and the amphitheatre in the college with its revolving table, used alike for the dissected cadaver and the patient undergoing surgical operation, has been displaced

by the microbe-proof operating arena with sterilizing apparatus, glass cases for the deposit and care of instruments, perfect ventilation and lighting. The operating surgeon in his linen duster with his assistants in shirt sleeves have been banished, and in their places are the surgeon, assistants and nurses enrobed in white, with masks, hands thoroughly scrubbed and rubber-gloved, with trimmed finger nails freed from microbe accumulations. The unbathed patient, in possibly street-walking garments, gives place to the scrupulously bathed and appropriately robed patient, with operating field cleansed with microbe destroying agents. Thus equipped, the surgeon enters any cavity of the body with impunity and attacks with expected assurance of success morbid conditions involving organs and parts heretofore beyond his power to assault—safe through his ignorance.

In our country, antiseptic surgery was to a certain extent a plant of slow growth. Learned teachers of surgery in our colleges, some too old to accept readily new things, some too young to appreciate its far-reaching importance and grasp its power, and still others doubtful as to its true value, referred to it as something new and to be proven. It happened at the introduction of the system of Sir Joseph Lister that the writer was one of the corps of lecturers in the Summer School of Jefferson Medical College. The subject he taught was practical operative surgery, and he endeavored, to the best of his ability, in his course of instruction, to teach the principles of this great system. In his hospital practice in St. Mary's Hospital, Philadelphia, in association with his colleague, Dr. W. W. Keen, he practiced antiseptic methods of treatment, employing the crude carbolic oil putty as a surgical dressing. It is believed that this practice of the antiseptic methods of treatment by Dr. Keen and the writer was the first carried out in the city of Philadelphia. Despite the warning sent to the writer by the learned professor that he must cease teaching the so-called new fangled and harmful system, he continued to teach the subject, and was greatly gratified to know within a year's time, that the messenger who had con-

veyed the injunction issued, was as enthusiastic and earnest an advocate of the system, both in his lectures and practice, as the writer.

Such is a simple description of the old and the beginning of the new in surgery, as experienced by the writer in the period of time set apart. He has endeavored to place on record events which have come under his own observation and which show not only the conditions which then were in existence and with which the surgeons of the day wrestled heroically, but those which exalt to the pinnacle of successful endeavor the achievements of to-day. In the ranks of the practitioners of surgery in those days there were stalwarts, men of resource, men of courageous convictions. With the facilities then possessed it was indeed a battle to win success against an enemy ever present, but unknown and concealed.

To-day the patient requiring surgical treatment, enters the hospital, private or public, constructed upon methods the most modern, and with full equipment for perfected work; from the door of entrance he passes from department to department, submitted in each to critical examination, and finally reclines upon the operating table, a transparent body into and through which the eye of science has penetrated, revealing the hidden morbid conditions, the significance of which the trained intellect of the expert has fathomed. At the operating table stands the surgeon with complete record in brain and knife in hand, to prove its accuracy and reveal it to the naked eye. With deft touch he excises morbid masses, shapes and fashions parts, reconstructs organs and restores halted function. Thus reconstructed, the patient emerges from the modern hospital a faultless specimen, illustrating the high art of the master hand.

And what is the future of surgery in the coming half century? Has the climax of surgical technic been reached? Is the earnest worker in surgical science satisfied with the present state of diagnostic precision? Is there not a large and inviting field for pathologic research? The work in this direction has already begun, and in the list of our Fellows

there are able and zealous workers laboring to unravel the entangled problem of the abnormal, the abortive cell,—to devise the means of retarding the action and checking the growth of the over stimulated cell,—to so control cell development and cell growth that homologous and heterologous formations will have no lodgment in the tissues and organs of the body—to formulate, may we not say, the proposition of preventive disorders which find their relief, too often unsuccessful, in the knife of the surgeon? Will organ substitution, the replacement of a diseased organ by one in every respect in a state of health, find a legitimate and established position in surgical art? Will the operative surgeon enlarge his sphere of action and become as well the constructive surgeon, doing the combined work of architect and builder? Are these the fantastic images of a prophetic vision? The history of the development and growth of surgery in the past gives reality to our expectations and hopes of what the future may unfold, and is this, in truth, not the great work of the surgery of the future?

SUDDEN DEATH: A STUDY OF CERTAIN CASES OCCURRING DURING PHYSICAL EXERCISE OR PSYCHIC SHOCK.*

BY JOHN BAPST BLAKE, M.D.,

OF BOSTON, MASS.

Instructor in Surgery in Harvard University; Assistant Surgeon to the Boston City Hospital.

About two years ago, a gentleman apparently in superb health, well known and much beloved in Boston, dropped dead while playing hand-ball. This event and the subsequent autopsy, both of which will be later described, brought vividly to the writer's attention the subject of unexpected sudden deaths, and this brief paper is a summary of observations made since that time. The first question involved was whether it is possible for a practitioner to foretell such a calamity in an individual patient, and if so to prevent or at least postpone it; the second inquiry seeks to determine whether the meagre information obtained can be utilized by the surgeon. The obvious difficulties surrounding the subject make it impossible to offer a final decision, based on a sufficient number of facts scientifically observed, in relation to either of these questions; but certain suggestive and frequently recurring features seem worthy of consideration.

Definition.—For the purpose of this paper, sudden death is defined as a phenomenon unforeseen, due neither to trauma nor to poison, whose duration is measured by minutes, and whose subjects in a vast majority of instances are supposed to be free from organic life-threatening disease.

Frequency.—Within the past two years the writer has collected from the medical and lay press, from medical examiners, and from other sources statistics of more than two hundred sudden deaths. This number represents by no means an exhaustive or thorough search for these fatalities, and is probably not more than one-half the total number which

* Read before the American Surgical Association, June 5, 1909.

actually occurred during this period in the northeastern section of the United States.

A small proportion of these notes include autopsy records and a somewhat larger number are accompanied by personal interviews with, or letters from parents, relations, friends, or eye-witnesses. The ideal record of a sudden death would include an accurate and complete previous history (and if possible a physical examination), and an autopsy made by a competent pathologist. Unfortunately, both of these sources of information are absent in a large majority of cases, and when one is available, the other is almost certain to be missing.

The records of medical examiners or coroners' physicians should be and are numerically our chief sources of information; but even these usually lack a thorough previous history, and an autopsy is permissive only in cases which are non-traumatic. In fact when sudden death seems, in the judgment of the examiner, due to "natural causes," an autopsy need never be made; and this is the precise class in which we are most interested, and the sources from which we could learn most are thus unfortunately greatly limited at the very fountain head. In spite of this, however, the figures are sufficiently large to be impressive.

Draper ("A Text Book of Legal Medicine," 1907) gives the following figures for sudden deaths due to "natural causes":

STATISTICS OF MEDICAL EXAMINERS.

FERRARIO and SERMOINE of Milan observed.....	1043 cases
WESTCOTT, coroner for Middlesex district, London, in 1000 consecutive deaths which were the subject of inquest, saw due to "natural causes"	303 cases
DRAPER himself, from 1877 to 1903, saw..... (of which 475 came to autopsy).	1850 cases
BROUARDEL ("Death and Sudden Death,") refers to ..... and says that "the two groups of infanticide and sudden death together constitute two-thirds of the medicolegal autopsies made in France annually."	1000 cases
The writer has collected, apart from the above, notes upon	225 cases
Total	4421 cases

No further argument is needed to demonstrate the fact that these unfortunate incidents occur with rather surprising frequency.

Causes.—Draper enumerates thirty-three causes, many of which might be subdivided into several distinct conditions; Brouardel gives no less than seventy causes. Among these, however, are many which would be eliminated for practical purposes in deaths limited to the class considered in this paper; such are pneumonia, Bright's disease, alcoholism, cerebral hemorrhage, peritonitis, meningitis, pericarditis and similar diseases. It is true that these may at times be ended by a sudden death, but it is only infrequently "unforeseen" and seldom within our accepted definition of time. Even cerebral hemorrhage is in the very great majority of cases a cause of death measured by hours rather than minutes (Loomis, Draper), the rare exception being when the medulla is the site of the lesion.

Within the definition of this paper the common causes of sudden non-traumatic unexpected death are: status lymphaticus, myocarditis, arteriosclerosis (particularly of the coronaries), thrombosis and embolism (particularly pulmonary), hemorrhage (aneurism, pancreas), acute dilatation of heart, rupture of heart, alcoholism, valvular heart lesions.

To these must be added, as exciting causes or conditions: severe or unusual exertion, moderate exercise, fright or intense emotion.

Age.—Sudden death is more frequent after the age of 40 than before, and much more frequent after 55 years. Yet the number under 30 is considerable, and youth and even childhood is not entirely exempt. Percentages are difficult to obtain, but it is probably well within the truth to say that less than one-quarter of the sudden deaths occur before the age of 40.

Conditions Present.—It has been already noted that autopsies in these cases are all too infrequent, and that complete previous histories are almost unknown; in addition to this, it is a fact that a certain percentage of deaths occur in which

even an autopsy fails to discover the cause. Brouardel places this percentage at 8 to 10. It becomes therefore all the more important to study the *conditions* under which sudden death occurs, and which seem to be its immediate exciting cause; if we find certain conditions preceding death with considerable regularity and constancy, it is fair to infer that these conditions play an etiological rôle, and should therefore be studiously avoided, or if this be beyond our power, should be diminished indefinitely towards the vanishing point.

In the 225 cases collected by the writer, these conditions have been noted with some approach to accuracy. They may be roughly classed in four groups: (*a*) severe or unusual exertion; (*b*) moderate exercise, or habitual non-laborious occupation; (*c*) quiet, rest, sleep; (*d*) fright, surprise, intense emotion, psychic shock.

These again are of necessity relative terms, since severe exertion for one might be moderate exercise for another; but if translated always in reference to a given individual, they become as definite and arbitrary as any we can hope to obtain. The essential point to be considered in each case is whether the condition is something usual or unusual for the individual, something to which he is or is not accustomed. Beyond this, however, there are certain other qualifications; some exercises are always severe, no matter who may undertake them; such are racing, high mountain climbing, struggles with men or beasts. Indeed, simpler forms of exercise may at one time be severe, at another distinctly moderate: for instance, in one case a drummer marching with his band falls dead while beating his drum; if this were a hot day after a very long march, it should be classed as excessive; if it were at the beginning of duty it might fairly be called moderate.

In examining these 225 cases, it became evident that a very small percentage of deaths occurred either during or immediately following extremely severe exertion; this seemed at first paradoxical until it became evident that in very many conditions predisposing to sudden death, extreme exertion, particularly of a sort often repeated, would be impossible; this

is particularly true of school and college athletics, and apparently explains the infrequency of non-traumatic sudden deaths in athletics throughout this country in spite of the enormous number of boys and men who indulge in strenuous sports.

Applying this classification to these 225 cases, the exciting cause or condition seems to be: (*a*) severe or unusual exertion in one-fifth; (*b*) moderate exertion in about one-fourth; (*c*) deep emotion or psychic shock in a little less than one-fifth. The remaining cases, about one-third of all, occurred during conditions of rest or sleep.

In reviewing the 225 cases, the chief difficulty has been in the choice of illustrations, as the number is almost indefinite.

CASES ILLUSTRATING SEVERE OR UNUSUAL EXERTION.

CASE I.—A gentleman of 50, of excellent habits, strong and athletic and a powerful swimmer, was playing hand-ball with a friend; just after a rally, he dropped to the ground and died immediately, without struggle or outcry. An autopsy showed arteriosclerosis and myocarditis, cardiac hypertrophy but no dilatation; the pathologist stated that this condition might well have been impossible to detect ante mortem, even by an expert. This gentleman was accustomed to take long swims in the ocean, to climb mountains, to play hand-ball, and was the last man that would be associated in the minds of his friends with organic disease. It later appeared that he had been seen to turn pale under severe exertion, and that on one or two occasions he spoke of a sense of oppression across the chest. It would seem, therefore, that the closest attention must be paid to the history of such experiences, as well as to auscultation and percussion, if in the future we are to detect cases whose essential lesions are myocardial or arteriosclerotic.

CASE II.—A powerful farmer was attacked by a mad bull; he defended himself by great exertion for nearly an hour, holding on to the bull's horns, and being violently thrown and tossed around. He was finally released, walked a short distance to his home, and fell dead at the door.

CASE III.—In 1877, Renforth, a celebrated oarsman, fell over during a fiercely contested four-oared race, at St. John, N. B. He was removed from the boat, and died in a short time. Autopsy showed a hypertrophied but otherwise normal heart and an intense engorgement of the lungs, which did not collapse on exposure to the air.

CASE IV.—Within the past year, two young men have died either during or immediately following a Marathon race.

CASE V.—A school-boy, 16 years old, was competing against a rival school in track games. He had already raced four or five times, and entered the quarter-mile run, which was bitterly contested. At the finish

he staggered and fell, and died immediately; his face was cyanotic and pupils widely dilated; the examiner did not make an autopsy, but called the condition "overstrain of heart."

It is an interesting fact that in a considerable number of cases in which cardiac disease is either recognized, or strongly suspected, the individual successfully withstands severe exertion, only to succumb, at a later period, to exercise more moderate.

A young college student, whose physical condition was supposed to be satisfactory, was a candidate for the football team; one day, before the regular practice, he ran a few steps and kicked the ball, returned to the sidelines, and fell dead. It was later discovered that his brother had died suddenly a few years before, and that this young man had been warned to beware of severe exercise; he had indulged in such exercise with but slight moderation, and had never experienced distress; but he died after an amount of exertion which was distinctly trivial.

A step beyond this is illustrated by a young man known to have a severe mitral incompetence, and prohibited by his doctor from taking part in any severe sport. In spite of the warning, he played both baseball and football; his friends testified at a later date that they had often seen him seriously distressed in both games; pale, very short of breath, and obviously exhausted beyond the condition of the average boy. He graduated from active sports and entered business. One morning, after breakfast, while in apparently excellent condition, he stopped for a moment to light a cigar while walking to catch a train; he was going up a very moderate incline, and was seen to fall; he died in a few minutes, without a sound or a struggle. This would seem to show that the excitement and nervous exaltation accompanying severe competitive athletics have a stimulating effect upon a damaged heart, and at times prevent it from stopping under a strain far greater than that to which, at a later period, it finally succumbs.

CASES ILLUSTRATING DEATH DURING MODERATE EXERCISE.

A man in apparent good health is mowing his lawn and drops dead.

A man who has not missed a day's work in twenty-one years drops dead while driving through the gate of the mill at which he was employed.

Another drops dead while shaving.

A milkman, delivering milk, falls dead at the door of a customer's house.

A man playing golf dies while hunting for a lost ball.

A farmer apparently in the best of health drops dead while driving his cattle home.

In all these cases the exertion is very moderate, and has been a habit for years.

Cases Illustrating Psychic Shock.—These cases are also numerous and interesting. Stephen Douglas, the son of the great rival of Lincoln, died suddenly; a few hours before, on its fiftieth anniversary, he had delivered a speech on the exact site where his father had contested the great issues with Lincoln.

A large number of deaths occur during speech-making: a noted temperance orator, in appealing to a youthful audience, came to the front of the platform and said with great earnestness: "Young men, take care of your records," and fell dead.

An old soldier, speaking at a reunion of a dead comrade whose vacant chair stood near him, became greatly affected and said, "But in the end the vacant chair always conquers," and fell dead beside it.

A Rabbi praying, a minister preaching, a penitent listening to a lecture on death, die without warning.

An apparently healthy boy runs to see a fire engine; just as he reaches the door of the fire house, the engine unexpectedly dashes out directly at him, but without touching him. He dies immediately, and autopsy shows status lymphaticus.

A sturdy farmer sees his son cut to pieces in a mowing machine, and falls dead; his son recovers.

A young woman sees her uncle step from a train and fall dead, and she falls dead beside him.

Such cases, always dramatic, could be enumerated almost indefinitely, to emphasize the fact that emotion is very often a potent factor in originating the processes which result in sudden death.

It is obvious, therefore, that emotion, exercise, and exertion are very frequently the exciting cause of sudden death. And a moment's consideration reveals the fact that these are precisely the conditions preceding and accompanying the average surgical operation. The apprehension and fright are very obvious, while the effect of the anæsthetic upon pulse, respiration, skin, and kidneys is precisely that of moderate exercise; furthermore, the effects of long-continued and very serious surgical interference are again precisely analogous to very severe exertion. We have, therefore, in the routine of modern surgery, reproduced with considerable accuracy the precise conditions under which a majority of sudden deaths occur. Is it not a fair inference that many of the all too fre-

quent deaths said to be due to anæsthesia, are simply coincidental, and would have occurred with equal certainty under any other procedure which reproduced these precise conditions?

Sudden deaths before, during, or immediately following operation are too common, and undoubtedly many occur that are not reported. The writer has been informed of six in the past year in which with perhaps one exception neither the anæsthetic nor the operation seemed a sufficient cause. It is notorious to those who concern themselves with anæsthesia, that ether and chloroform are frequently blamed for catastrophies for which they are not wholly, or at times even in part, responsible.

The more we know of the real nature of these deaths, the better shall we be able to avoid them. Certain facts stand forth. We cannot yet predict with any certainty the individuals who are doomed to sudden death, nor the time of its occurrence, but we do know many of the pathological conditions which predispose to it, and the circumstances under which it most frequently occurs. In endeavoring to guard against it we must remember:

1. The comparative frequency of status lymphaticus. At least eight cases have come to medicolegal autopsy as the result of sudden death in Boston within the past year, and in the experience of only two medical examiners. Another has been withheld from operation by the skilful diagnosis of a physician; another died shortly after a simple circumcision. It is believed that the diagnosis can often be made in advance by attention to the possible presence of a thymus, bowing of the femurs, a thick, short neck, and, in men, pubic hair of the female type. Of the eight cases upon which autopsy was done six died almost instantly, and two some hours after a slight injury was received.

2. The invariable necessity for a more thorough and complete physical examination and personal history before operations even of a minor character.

3. The importance of diminishing to a minimum pre-anæsthetic fright, apprehension, and intense emotion, for the

sake of the patient's safety as well as comfort. (Dr. Crile has reported an admirable method of doing this in thyroid cases.)

4. The very great importance of complete histories and autopsies in every case of sudden death, an end which can be best attained by securing the active co-operation of medical examiners and coroners' physicians.

5. The necessity of the careful report of every case of operative sudden death, even if no autopsy is obtained, by the surgeon in charge of the case. It does not seem essential that such reports should be originally presented to the world at large, but they might well be made to a small committee of this Society and by them examined and analyzed, and the essential facts brought to the attention of the medical public.

Dr. Blake would greatly appreciate any notes of sudden deaths of the character above described, which have occurred under the observation of the members of the Society.

THE TREATMENT OF TETANUS BY CHLORETONE.*

BY WILLARD HUTCHINGS, M.D.,

OF DETROIT, MICH.

THE indications presented by a case of tetanus are: First, to remove the source of toxin supply. This can be accomplished by thorough local disinfection or by amputation. Secondly, to neutralize the toxin present in the circulation which has not yet combined with the nerve cells. This is done very well by the injection of sufficient quantities of antitoxin. And this is all antitoxin will do. There are no theoretical grounds for belief and no clinical evidence to show that it affects, in any way, either the growth of the germ or the nerve cell-toxin combination. Thirdly, to keep the patient alive until the body can overcome the effects of the toxin which has already entered into combination. Death in a vast majority of cases results from one of two causes. Either the amount of toxin is so large or so active that it directly affects a weak heart or the vital centres in the medulla, the patient dying in a few hours; or death results from exhaustion following the prolonged and severe muscular contractions. Practically all the former class will die. It is in the latter class, those which die from exhaustion, that treatment is more hopeful.

The object here is to control the muscular contractions, for it is as the result of these, directly or indirectly, that the patient dies. Directly, a prolonged severe convulsion may prevent air entering the lungs, the patient dying of asphyxia. Indirectly, prolonged violent muscular action produces greatly increased amounts of poisonous katabolic products which must be eliminated. At the same time, elimination by the lungs, the intestines and the kidneys is interfered with. Together with this, it is also frequently impossible to give sufficient nourishment. This unfortunate combination soon leads to a

* Read before the American Surgical Association, June 5, 1909.

fatal issue. Provided the muscular manifestations can be controlled, we can prevent the increased katabolism, aid the eliminating organs to free the body of toxin and give sufficient food to maintain the strength of the patient. To this end a number of agents have been recommended. Some time ago, in conjunction with Dr. Charles T. McClintock, I began a comparative experimental study of the various methods of treatment which have won a recognized place in tetanus therapy. As the result of these experiments, we became convinced that chloretone was the best substance which had thus far been employed for the purpose of controlling the muscular manifestations of the disease. I have had the opportunity of treating six cases of tetanus which have been referred to me by this method with five recoveries. Of these, one was mild; one moderate; three severe and one fulminating. They are as follows:

CASE I.—Hungarian, 26 years old. Admitted to St. Mary's Hospital December 13, 1907. Seven days before admission, six before the appearance symptoms, he crushed the distal phalanx of the middle finger of the left hand with a hammer. It was washed with water and wrapped in a clean cloth. He did not consult a surgeon and no further dressing was attempted. On the morning of the 13th he complained of stiffness in neck, inability to open his mouth and pain in his back. This condition became worse during the day and that evening he was removed to the hospital. He was given 1500 units of antitetanic serum every twenty-four hours together with large doses of morphine, chloral, and bromides. Despite this treatment, he became worse. I first saw him at 7 P.M., December 17. At this time he was in marked tetanus. Clonic convulsions were frequent and severe, opisthotonos being marked. He could separate the teeth ½ cm. and could swallow. Thirty grains of chloretone dissolved in one-half ounce of whiskey were given per mouth at 8 P.M. At 8.15 he was sleeping naturally with all his muscles completely relaxed. The jaws could be opened to their fullest extent. Vigorous palpation, loud talking, and the flashing of an electric light in his eyes caused no response. He remained sleeping quietly until 1 A.M. of the eighteenth, when he awoke. The previous

symptoms returned but were not so severe. Twenty grains of chloretone in whiskey were at once given. This kept him quiet most of the time until 1 P.M. He could now swallow freely, and took nourishment readily. He had no return of the clonic contractions. From this time the tonic contractions gradually lessened. He was able to open his jaws freely on the twenty-second and on the morning of the twenty-third ate dry toast, chewing it well. The finger was amputated on the eighteenth. He received 1500 units of serum and 30 grains of chloretone daily until the twenty-second, when they were discontinued. At 4 P.M. of the twenty-third, the patient complained of severe pain in the abdomen, and the temperature, which had been normal since the nineteenth, went to 103 with pulse of 140. He became rapidly worse and died at 6 o'clock the morning of the twenty-fourth. During this time there were no symptoms of tetanus.

Autopsy showed a perforation of the colon near the splenic flexure, and general peritonitis. Cultures from the peritoneal exudate and heart blood showed a streptococcus. This patient had recovered from tetanus and all treatment had been suspended. He undoubtedly died as a result of the peritonitis. Cultures from finger were negative for tetanus.

CASE II.—Female, unmarried, 23 years old. Had an abortion performed May 11, 1908, at 3 P.M. Did well until May 17 at 6 P.M., when she noticed that she moved the jaws with difficulty. This became worse, and on the eighteenth she could take no solid food, and swallowed fluids with difficulty. Her condition became worse on the nineteenth, when she had her first clonic convulsion. These increased in frequency and severity until the twenty-second, when she was removed to St. Mary's Hospital. I first saw the patient at 10 A.M., May 22. At this time she showed well-marked tetanus. The muscles of the entire trunk were in tonic contraction—limbs not affected, head drawn back, muscles of mastication rigid; could open mouth ½ cm., and was unable to approximate chin to sternum. Clonic convulsions were frequent and severe. An attempt to examine the patient's abdomen caused a violent convulsion lasting one minute. She was at once taken to the operating room and curetted under chloroform. An emulsion of these curettings injected into 350 Grams guinea pigs caused death from tetanus in six days. While under the anæsthetic, a stomach tube was passed and 30 grains of chloretone

dissolved in whiskey given. This was almost immediately regurgitated. Two thousand units of the antitetanic serum were given subcutaneously and 2000 intravenously. On recovering from the anæsthetic, she was unable to swallow, and all previous symptoms returned. Thirty grains of chloretone dissolved in hot olive oil were given per rectum and retained. One hour later, the patient was sleeping quietly, all muscles were completely relaxed while the mouth could be opened to its fullest extent. She remained in this condition until the following morning, when there was some rigidity of the abdominal and neck muscles. She could open the jaws about 1½ cm., and took nourishment readily. An attempt to test the patellar reflex caused several slight convulsions. The dose of chloretone was repeated. Within 30 minutes she was sleeping quietly, completely relaxed. From this time she made an uninterrupted recovery. The chloretone was repeated every 48 hours until May 30, when it was discontinued. Three thousand units of antitetanic serum were given daily subcutaneously. During this time she took fluids readily. Four litres of saline solution were given per rectum every 24 hours. Large quantities of urine were voided voluntarily and the bowels were moved freely by large doses of cascara. She was discharged June 8, cured.

Case III.—Was a moderately severe one following a blank cartridge wound of the hand. The incubation period was 10 days. This case yielded perfectly to treatment as outlined above and was discharged cured.

Case IV.—Pole, male, 24 years. Was admitted to Harper Hospital May 28, 1908, for a severe crushing injury to left hand sustained in manipulating a bread-mixing machine. The soft parts, particularly on the palmar surface, were badly lacerated. No bones were broken. After disinfection with soap, alcohol, and bichloride, the bleeding vessels were ligated with catgut, and the parts approximated with catgut and silkworm sutures. Infection followed, and a large portion of the flaps sloughed. On June 15, the necrosed integument and portion of three fingers were removed. At the same time, a skin flap from the abdomen was sutured to the dorsal surface of the hand, the arm being retained in position by bandages. On June 22 this flap was removed from its attachment. On June 29 a similar flap was applied to the palmar surface of the hand, and on July 6 this was removed

and the abdominal wounds sutured with catgut. The patient did well until July 15, when he complained of stiffness of his jaws and pain in his back and neck. He became worse despite large doses of morphine and bromides and 1500 units of serum. I saw the patient at 9.30 A.M., July 19. At this time he was in severe tetanus: unable to separate the jaws or swallow. Seventy-five grains of chloretone were given in olive oil per rectum. The wounds were curetted and washed with hydrogen peroxide. Cultures from these were negative for tetanus bacilli. Forty-five hundred units of serum were given intravenously. At 3 P.M. he could separate the jaws 2 cm. and swallow freely. From this time forward he had occasional clonic convulsions until July 26, when they ceased. The tonic contractions disappeared gradually, being completely absent on the twenty-seventh. Sixty grains of chloretone were given on the twentieth and twenty-third, and 30 grains on the twenty-sixth. Fifteen hundred units of serum were given subcutaneously daily until July 28, and elimination forced as much as possible. He was discharged cured August 4.

CASE V.—This was a mild case following an extraperitoneal shortening of the round ligaments. The incubation period was 12 days. She yielded readily to treatment, making an uninterrupted recovery.

CASE VI.—American, 52 years old, chronic alcoholic. On January 25, 1909, patient fell from scaffolding, sustaining an open fracture of the right arm at the elbow. This was reduced by Dr. T. A. McGraw, at St. Mary's Hospital, at 11 A.M. The case pursued an uneventful course until the evening of January 29, four days later, when he complained of severe pain in his fractured arm and in back. At 10.30 there was some rigidity of the jaws and difficulty in swallowing. During the night he received one grain of morphine and slept at intervals, complaining of pain when awake. At 7 A.M. January 30, he had severe clonic convulsions. I saw the patient at 9.30. He was sitting up in bed in a state of marked emprosthotonos. His clothing was soaked in perspiration. The muscles of the entire body except the arms were in a state of marked tonic contraction. He was unable to separate the jaws in the slightest degree or to swallow. *Risus sardonicus* was pronounced. During the five minutes of observation, he had eight severe convulsions. Seventy-five grains of chloretone in two ounces of hot olive oil were given at once per

rectum, and retained. Under light chloroform anæsthesia, the wound was opened by Dr. McGraw, thoroughly curetted, washed with hydrogen peroxide and packed with gauze saturated with balsam Peru. He was returned from the operating room at 11 A.M. At 11.30 he was sleeping quietly, all the muscles relaxed, the jaws being widely separated. Patellar reflex very slight. Vigorous palpation of the abdomen caused three slight clonic contractions. At 12 o'clock, cultures were made from blood taken from the left median basilic, with the idea of determining the presence of the tetanus bacillus. Unfortunately the cultures were broken on the way to the incubator. However, two 350-Gram guinea pigs were inoculated, one with two c.c., the other with one c.c. of the blood from the same source. Both pigs showed well-marked tetanus at the end of 24 hours, and were dead at the end of 60 hours. Cultures from the wound were positive for tetanus bacillus. Forty-five hundred units of the antitetanic serum were given subcutaneously near the brachial plexus. The patient awoke at 1 P.M. and complained of pain in his arm. At this time there were no tonic contractions. He could open his mouth one inch and swallow with little difficulty. He had occasional slight tonic contractions during the afternoon, and at 3.30 received 50 grains of chloretone in one ounce of olive oil per rectum. He remained quiet until 10.15 P.M., when he began to have severe clonic convulsions. Fifty grains of chloretone in olive oil per rectum was almost immediately expelled. On account of the frequency and severity of the convulsions, he was anæsthetized and 50 grains of chloretone in 1 ounce of whiskey given per stomach tube. The effect was almost immediate. At 11 P.M. he was sleeping quietly, completely relaxed. He remained in this condition until 3 A.M. of the 31st, when pulse began to fall. At 9 A.M. the pulse was 170–180 and thready. At the same time, the respirations were 30, full and regular. Notwithstanding the administration of large quantities of saline by hypodermatoclysis and oxygen, the heart became gradually weaker. The pulse was imperceptible at 10.45 A.M. The respirations remained good until the pulse stopped, when they gradually became weaker and he died at 11.10, completely relaxed. Postmortem was not allowed.

I attribute death in this case to the direct action of the enormous amount of toxin in the blood on a weakened heart.

It has been demonstrated by animal experiments that chloretone kills by acting on the respiratory centre without affecting the circulation. It will be noted in this case that while the pulse was very bad, the respirations were only slightly affected, and that the patient died from failure of the circulation, not the respiration. If I were again confronted with a similar condition, I would bleed the patient freely, replacing the blood with salt solution. This would immediately remove a large amount of toxin and possibly prevent heart failure.

In summarizing these cases it will be seen that three of them, Cases I, II, and IV, were of the type which almost always die. Case III might have recovered; Case V would probably have recovered under any treatment; while Case VI was the type which will usually die despite treatment. It will be noticed that the muscular manifestations were completely controlled in every case by the chloretone. This is all chloretone will do. It has no effect on the toxin circulating in the blood, nor will it break up the combination between the nerve cells and the toxin, when this combination has taken place. It has the further merit of being harmless. No fatal cases following its use have been reported although enormous doses have been taken with suicidal intent. In addition to this, it is easy of administration. If the patient can swallow, it can be given by mouth dissolved in dilute alcohol. If this is not possible, it can be given per rectum dissolved in hot olive oil. I have given it this way in my later cases because its action is almost as prompt as when given by mouth, and it does not disturb the stomach. In addition to this chloretone lowers the temperature and has a slight diuretic action.

ANEURISMS IN YOUNG PEOPLE.*

BY THEODORE A. McGRAW, M.D.,

OF DETROIT, MICH.,

Professor of Surgery in the Detroit College of Medicine; Surgeon to St. Mary's and the Harper Hospitals.

I HAVE had two cases of aneurism in young men of 16 and 17 years of age. They were both associated with great dilatation of the heart and, in both, the arteries were soft and fragile.

The first case occurred nearly thirty years ago. I have lost the notes which I made of it at the time, but have a very distinct recollection of its main features. A country boy of 17 years, while working in the field was seized with a sudden pain in the bend of the right elbow and became incapacitated for work. He came to me a week afterwards for examination and treatment.

I found a pulsating tumor of the lower end of the brachial artery, and a great enlargement with dilatation of the heart. I could elicit no history of rheumatism or syphilis.

I operated on him and found an aneurism of the brachial just above its bifurcation, about as large as a hickory nut. It had ruptured and was surrounded by a large quantity of extravasated blood. I tied the artery above and below the aneurism. The upper ligature cut through as soon as tied, and I was obliged to tie it again higher up.

At the end of three days a secondary hemorrhage occurred from the cardiac end of the artery. The ligature had cut through the soft arterial walls. This happened a third and a fourth time at intervals of between three and four days, necessitating repeated ligation, each succeeding one from half an inch to an inch above its predecessor. I finally succeeded in checking the hemorrhage permanently by passing a pin under the vessel at its origin from the axillary and pressing its walls together by a figure-of-eight thread wound carefully and not too tightly around it. The wounds were at no time septic, and healed quickly. He left the

*Read before the American Surgical Association, June 5, 1909.

hospital with full use of his arm, but died at his home from the heart trouble a year and a half afterwards.

The second case was that of a boy sixteen years of age, from Wyandotte, Mich., who entered St. Mary's Hospital, Detroit, on June 26, 1908, and came under my care. According to the history which I elicited from himself and his mother, he had been subjected during his life to many hardships, and had worked beyond his strength. He had not been conscious, however, of any cardiac or pulmonary trouble, and had believed himself well until three weeks before his admission to the hospital, when he was seized with pain under the right knee. This was diagnosticated as rheumatism.

It was positively stated that he had never, prior to the outset of this malady, suffered from rheumatism or any other acute or constitutional disease. He gave no history of strain or injury. A few days before I saw him a pulsating swelling was noticed in the right popliteal space, and he was sent to Detroit for treatment.

On examination, I found a pale, anæmic lad with a very large dilated heart and a soft, collapsible pulse. The apex beat in the sixth intercostal space half an inch outside of the nipple. There was a loud, blowing murmur, heard equally at base and apex, and confusing both sounds of the heart. His pulse, 100 in the minute, was very soft and compressible. His temperature was 100° F.

In the right popliteal space there was a pulsating tumor filling up the whole concavity. His leg was flexed and could not be extended without pain. There was a constant pain, even when he was in bed and quiet, which radiated down the leg to the foot. His urine was normal. There was no leucocytosis. The report of blood examination showed the amount of hæmoglobin to be 80 per cent. of normal. He had no cough nor dyspnœa nor other evidence of lung complication, but was so weak and exhausted that I deferred operating until his strength could be recuperated by rest and treatment.

During the next three weeks he regained his appetite and grew stronger, but his temperature continued to fluctuate between 99° F. and 100° F. and his complaint of pain was constant.

The operation was performed on July 18, a hypodermic injection of morphine having been administered a quarter of an hour before the ether anæsthesia. Through a long longitudinal incis-

ion a cavity was opened in the ham, containing a large mass of extravasated blood. When this had been evacuated and the parts cleansed there was revealed an exceedingly thin and small aneurismal sac with a linear rent in its posterior surface. The sac was nowhere adherent to the surrounding tissues, and its walls, thin and fragile as a peritoneal membrane, were not re-enforced by fibrinous or calcareous deposit. On freely enlarging the opening, I found that the sac consisted of the whole posterior wall to the extent of half an inch. The anterior wall appeared as a groove in the tissues, extending from the upper to the lower orifice of the popliteal artery. I could detect nothing which had any resemblance to embolism, and the condition was rather that of a vessel distended beyond its tensile capacity than one that had been subjected to septic deposits and irritations.

I had thought to use the Matas method in operating, but found the arterial and sac walls too soft and thin for that procedure. The sutures cut through the tissues on the slightest traction, and the first ligature, which was tied with some force, came away in my hands. I tied the artery above and below the sac, therefore, with great care, drawing the threads together just tight enough to prevent hemorrhage. A rubber drain was inserted, and the wound closed around it by layers of catgut sutures. The drain was removed on the third day, the wound healed by first intention, and I was able, at the end of a week, to apply a weight to the foot to extend the flexed knee.

On August 18 he was sent home, walking upon a well leg and with no untoward symptoms. He died on November 14, but I did not hear of his demise until some time in December and was prevented from making a post-mortem examination. On the death certificate it was stated that he died of endocarditis.

These cases seem to me to have some importance because of their bearing on the pathology of aneurisms in young people. In both cases there was great enlargement and dilatation of the heart, without history of rheumatism or other acute disease. In both, the arteries, though apparently normal, were very soft and friable. In the second case this may have been the result of the long irritation due to the rupture of the sac, but in the first case, in which the whole brachial artery was affected, it is impossible to regard the arterial insufficiency

as the result of a merely local affection. The entire absence in both cases of all evidences of arteriosclerosis, septic infection and embolism would seem to indicate that the relations between the cardiac disease and the arterial were those rather of coincident affections than those of cause and effect. The question arises whether many cardiac maladies occurring in childhood and youth may not be the result of failures in development which involve not only the heart but also the whole vascular system. We might expect to find these relations more especially in those dilatations of the heart in which the valvular affections were not sufficient in themselves to account for the severity of symptoms.

In children, with defects in development of this nature, hardships and severe labors may act as supplementary and exciting causes of arterial ruptures and aneurisms by bringing strains upon the vessels which they are not able to resist.

It is curious that the congenital insufficiency of the circulatory system which undoubtedly exists in some children has received only a very grudging notice on the part of pathologists.

Tubby states that "there exist in young people traumatic aneurisms without pre-existing inflammatory lesions of the arteries. He believed that rheumatism and syphilis, and probably alcoholism, creates in the descendants not only lesions but also congenital malformations of the arteries, which consist in a more or less complete disappearance of the elastic fibres, of the middle coat, and favors the appearance of aneurism in the fœtus and infant."

Jacobi includes among the causes of aneurism in children a congenital incompetency of the walls of the blood-vessels. This view of the etiology of many aneurisms in children finds support in a number of cases on record in which the heart is reported as normal. They are:

1. That of ARMITAGE, of a child seven and a half years old who had suffered from palpitation from her earliest infancy. She died of an aortic aneurism. The arteries on obduction, were found to be free from atheroma or roughness.

2. WORMASKI's case of aneurism of the ulnar artery and palmar arch in a girl of twelve. The child had had no hereditary taint or rheumatism, and he attributed the disease to a strain received from lifting.

3. KEEN's case of a spontaneous arteriovenous aneurism of the arm and also an aneurism of the chest in a girl of eighteen.

4. ROGERS, a girl of ten with aortic aneurism; she had never had rheumatism or scarlet fever.

5. RIES, a girl of five, with aortic aneurism.

6. PENDEL, aortic aneurism in a girl of twelve. He referred the trouble to a fall on the chest received six years before the development. We may be permitted to doubt whether there was any causal connection between the injury and the aneurism.

7. F. G. SMITH. Boy of nine, with aortic aneurism.

8. BERRY. Boy of fifteen, died of aortic aneurism. He had never had rheumatism, and there was no evidence of hereditary syphilis. The only sign of heart trouble was a slight thickening of the aortic valves.

9. MIGUEL. Boy of fourteen, died of aortic aneurism.

We may hardly assume that these nine patients with normal hearts owed their maladies to embolism, either mechanical or septic, as the conditions which cause embolism were entirely absent from their histories. Neither are we justified, in my opinion, in ascribing them to an hypothetical endarteritis, of which there is no other evidence than the existence of the aneurism itself. How far we may go, however, in referring their origin to pre-natal disturbances is as yet an unsolved problem.

If we study the recorded cases of aneurism in children, we shall find very few satisfactory data on which to base our opinions as to their etiology. Dr. Charles Pfender compiled sixty-four cases for me from the literature in the Surgeon General's library. Thirty-two of these were so meagrely reported as to give no clue whatever to previous history or hereditary influences. Of the thirty-two remaining, six gave more or less uncertain histories of injury. One case was attributed somewhat doubtfully to an abscess which ruptured into the aorta.

In nine cases there was history of previous attacks of rheumatism. In ten it was positively stated that the patients had never suffered from that disease. In view of the fact that rheumatism is an exceedingly insidious disease in children,

often causing inflammation and dilatation of the heart before manifesting itself by muscular or arthritic pains, I cannot think that these figures represent, even approximately, the actual facts.

As regards syphilis, which is so generally credited with causing arterial degenerations and aneurisms, it is noticeable that in only one case, that of Wilson and Macy's, was there any evidence whatever of previous infection. Lebœuf, who is strongly disposed to regard hereditary syphilis as an important factor in the causation of arterial disease, admits, nevertheless, that he was unable to detect any signs of that disorder in his autopsies. It seems evident that the prevailing theories regarding this matter need careful study and revision.

In 5 cases aneurisms were found associated with tuberculosis; in 3 they were preceded by whooping cough. It does not appear that any of the 64 patients had had scarlet fever. Two cases were reported to have had measles and one to have had a streptococcus infection. It is impossible from these meagre data to draw positive and trustworthy conclusions.

The relations between cardiac disease and arterial dilatations are not yet thoroughly understood. Clinicians are inclined to attribute aneurisms which occur in conjunction with valvular affections to embolism. That embolism is sometimes a cause of aneurism cannot be doubted. That it is a very common factor in its production has not been proven. It is certain that in some cases acute infections like rheumatism, scarlet fever and typhoid fever and measles affect the arteries primarily, causing thickenings and erosions of the intima and inflammations of the media. Osler states that it is rare to find the arteries entirely free from disease. Even in children, small flecks of atheroma or fatty degeneration of the intima are by no means uncommon. It is not possible when cardiac and arterial diseases co-exist to distinguish those cases in which one is caused by the other from those in which the two arise simultaneously from the same infection. The difficulty in deciding as to the nature of these relations is increased by our inability to diagnosticate endarteritis in its acute stage.

Whatever symptoms occur, such as fever and pain, that it might present, are overshadowed and hidden from notice by the great cardiac disturbance. The heart disease is discovered in its early stages, while the associated arterial lesions do not attract attention until the subsequent degenerations have led to arterial dilatations. This may not occur for months or even years after the onset of the initial lesion, and often only when the artery is subjected to some sudden and unusual strain.

As regards the etiology of aneurisms in young people, we may say with some positiveness that in some cases there are congenital defects in development which are manifested by a thinness and softness of the middle arterial coats, and which render the arteries incompetent to resist even ordinary strains. We may surmise also that this condition may be due either to hereditary influences or to parental infections, but we have no data which enable us to determine with any exactness how important this factor is as a cause of arterial dilatation.

We have reason also to believe that the primary infections to which the arteries, especially, with the heart, are exposed, may induce lesions which may, in some cases, result in serious degenerations of the arterial coats and end in aneurisms, and there can be no doubt that emboli due to cardiac or other diseases may lodge in the arteries and affect them disastrously. The whole subject, however, needs to be studied *de novo* with more care in observing actual conditions and more criticism in judging the meaning of the ascertained facts.

GUNSHOT INJURY OF THE BRAIN.*

WITH LATE MANIFESTATIONS AFTER IMMEDIATE RECOVERY.

BY JOSEPH RANSOHOFF, M.D., F.R.C.S., (Eng.),

OF CINCINNATI.

Professor of Surgery in the Medical College of Ohio, University of Cincinnati.

It may be fairly asserted that abscesses of the brain present many difficulties of diagnosis, and that autopsies out of number reveal opportunities missed. That they may long remain latent is of common observation. But latency may be seeming and the result of inaccurate observation. The latter probably happens in the majority of instances. A notable exception, a case of true latency, was observed by the writer in the instance of a boy whom he trephined at the request of Dr. E. W. Mitchell for a compound depressed fracture of the frontal bone.

The patient, a lad of seven, had fallen from his bicycle and sustained a fracture in the region of the right frontal eminence. The dura was not injured. The depressed bone was replaced. The union was absolutely by first intention and the recovery unattended by any evidence of infection so far as the most careful clinical and bacteriologic observation could show. The patient left the hospital two weeks after the operation. During more than three years the boy's condition and development were in every way normal. He never missed a day at school by reason of ill health; never complained of headache, and was in every way well. In his school work he frequently led his classes. Three years after his injury he was suddenly seized with violent headache after becoming overheated at skating. He died in coma within twenty-four hours after the onset of symptoms. The autopsy revealed a ruptured abscess which had been encapsulated. It was a little larger than a pigeon's egg and in the right

* Read before the American Surgical Association, June 5, 1909.

frontal lobe directly under the site of the fracture. The bone scar was scarcely visible.

It may be of importance to note that the boy was the only child of very intelligent parents, who would certainly have noticed any deviation of health in him. It is, therefore, fair to assume that the abscess was latent during the time indicated.

The following case is that of an abscess seemingly latent for a number of years and one presenting a missed opportunity.

T. S. T. first presented himself to me June 3, 1907. He was then aged 43. Married. He has two children. The family history is negative. He has been a commercial traveller for five years. He was perfectly well until the 6th of May, 1899, when he was shot with a thirty-two calibre rifle fired at close range. The bullet entered an inch above the middle of the right zygoma. He remained conscious for a short time after he was injured and gave directions about calling a physician. He was not unconscious at any time. There was a short period of stupor which supervened about six hours after the injury was sustained and disappeared entirely after two days. From that time on he continued clear-headed. Immediately after the accident there was a paresis of the left side of the face, the arm, and the leg. This could not have been profound, as the patient got into a buggy, drove home, and alighted, with some assistance. He was in bed about seven weeks, after which time the paralysis began to improve. He was confined to the house altogether for about six months, and at the end of a year he was enabled to dress himself and go about. From that time forth he continued his business, which now was that of a stock broker, with few interruptions.

On the 1st of September, 1903, nearly four and a half years after the injury, the patient was seized with a severe convulsion associated with unconsciousness. The second attack occurred in February, 1904. Both of these occurred in a hotel room after retiring. During both of them he fell out of bed, and after the second he remained on the floor sleeping until morning. On the following days he was about his work as usual. During the following two years he had altogether four similar attacks. In

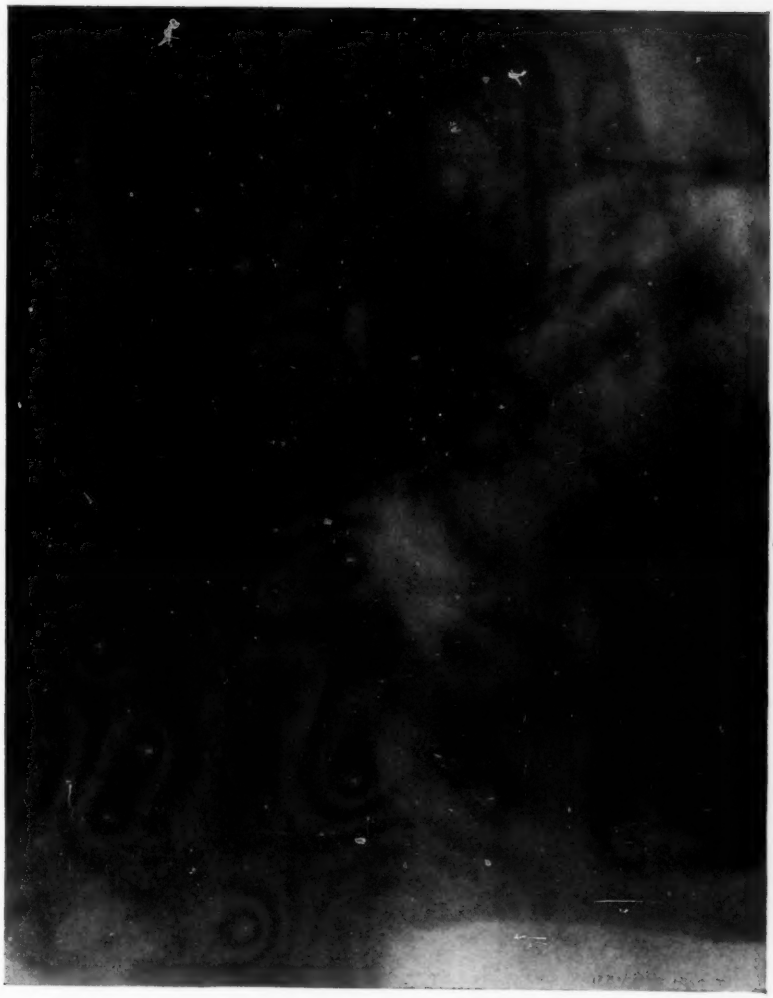
April, 1904, he consulted Dr. F. W. Langdon, to whom I am indebted for many of the clinical notes.

When the patient presented himself to me in mid-summer of 1907 with a view to operation for the relief of his epileptic seizures, his condition was as follows:

Stat. Præs.: Vigorous-looking man; height six feet; weight 220 pounds; pulse 76; heart and lungs normal; no evidence of increased intracranial pressure; no headaches at any time; ocular fundus normal; urine normal. His mental condition is normal in every regard. He is clear in his ideas and logical. There is no defect in speech, nor is there any trace of asteriognosis. The pupils act normally and the ocular muscles are unimpaired. Dr. Langdon found in 1903 a very slight weakness of the lower face on the left side and the mouth drawn slightly to the right. At the time of my examination this weakness had disappeared. Dr. Langdon also noted some dulness of taste and smell, but not localized on either side. This was not noticed in my examination. Movements of trunk and extremities normal. There is no incoordination. A dynometer test of the grasp of both hands is better than the average. The left sole is less sensitive than the right. The knee-jerks are weak but equal on the two sides. A most carful inquiry as to the history of the convulsions, of which the patient has about four a year, fails to show them to be of the Jacksonian type. X-ray plates were now taken by Dr. Thompson in anteroposterior and transverse diameters. They show the course of the bullet to have been slightly backwards, upwards, and inwards. The bullet was broken into three parts. The outer fragment was evidently in the temporal fossa and extracranial. The middle fragment was either just within or in the bony wall of the middle fossa. And the largest fragment was behind the sphenoidal sinus on a level with the cribriform plate, and it was impossible to state whether it was within the skull or not.

The writer believed the convulsions due to an irritation from either the second or third fragment or from a brain scar. But in the absence of any focal starting point of the convulsions, he was unable to determine which of the fragments caused them. It was natural to assume that the larger fragment was the one which, if an operation were determined upon, should have been the object of the search. Considering the excellent condition of the patient and the infrequency of the attacks, and the absence of the ordinary

FIG. 1.



Lateral skiagram of cranium.

FIG. 2.

Anteroposterior skiagram of cranium.

FIG. 3.

signs of increased intracranial pressure, and that the attacks became less frequent under rest and bromide, an operation was not advised. The writer did not again see the patient alive.

He learns that about a year after his last visit to him there developed a paresis of the left side of the face and of the left arm. There also was noticeable a slight dragging of the left foot. While in this condition, the patient came to the city for consultation on the 20th of February, 1909. Because I was out of the city, he concluded to return to his home, seventy miles away. An engagement was made for consultation two days later. While on the train that morning, he complained of a severe headache which came suddenly after a severe jolt. When he arrived in the city the headache became intense. Shortly after reaching his hotel profound coma supervened and the patient died ten hours after the onset of the acute cerebral symptoms.

The autopsy had to be hurried and was incomplete; only the head was examined. No effort was made to find the extracranial fragment. On removing the brain the right sphenotemporal lobe was found adherent to the middle fossa and removed with great difficulty. In the floor of this fossa was a small opening the size of the end of a lead pencil. The largest fragment was firmly imbedded in the cavernous sinus between two layers of the dura mater, and without question had been innocuous from the time of its lodgment there. The brain was removed as a whole and hardened and carefully examined by Dr. Wolfstein, neuropathologist of the Cincinnati Hospital, who has given me the report which follows.

Report of Dr. Wolfstein.—Brain given me for examination by Dr. Joseph Ransohoff showed an incision in the right hemisphere on the outer lateral surface evidently made during removal. No abnormalities on the convexity of either hemisphere. At the base of the right hemisphere situated directly underneath (and ventral) to the right cerebral peduncle is an egg-shaped cavity 4 cm. in diameter. On opening this cavity thick pus poured out and then the cavity was seen to have a depth of about an inch and a quarter and to be evidently walled off from the surrounding convolutions.

The cavity occupies a position at the base of the temperosphenoidal lobe extending forwards to the uncus, in fact to the anterior extremity of the sphenoidal lobe reaching to the Sylvian fissure, separated from it, however, by a portion of the compressed thin convolution before mentioned. It also occupies the anterior third, at least, of the gyrus occipitotemporalis and impinges upon the inferior temporal convolution. The

optic tract in its passage around the crus was in direct relationship with the roof of this cavity and may have been pressed upon, but does not appear in any way to be obliterated, although it does not appear to be as healthy as the tract on the opposite side. The optic chiasm, the mammillary bodies, and the third nerves appear perfectly healthy. On opening the cavity at the bottom, it extends inward into the substance of the uncus and the sphenoidal lobe as above mentioned and the wall of the cavity looks very much as if it had a pyogenic membranous lining. Lateral to the abscess cavity a firm substance can be felt, around which there is a marked fibrous thickening which is cut through with some difficulty, and encysted in the substance of this thickening a foreign body can be plainly felt. As said, it is completely surrounded by fibrous tissue.

On cutting through this tough fibrous thickening, a fragment of a bullet falls out, but it is remarkable how firmly encysted this piece of bullet was. I expected at first to find a large flattened mass of bullet, instead of which I found the tough fibrous material was five or six times the size of the bullet and in places a third of an inch thick.

On cutting away this mass, it was found that in its interior the mass was of the same consistency as cartilage. The abscess can be dissected loose without much difficulty from the structures which form its roof, and its roof lies directly under the medial convolutions of the island of Reil.

When the abscess cavity is removed completely a tongue of tissue forms its roof lying immediately ventral to the right crus cerebri. Immediately back of it can be seen the posterior edge of the right columna fornicis. There seems to be also a marked purulent infection of the overlying lateral ventricle. On turning the brain over and examining it from the top, a purulent infection of both lateral ventricles as well as the middle ventricle is very well marked.

The infection involves both the columnæ fornici and even the fibres of the upperlying corpus callosum. The tissues posterior to the roof of the middle ventricle, namely, the corpus callosum and the junction of the two columnæ fornici, are also the seat of purulent infection. On dividing these the choroid plexus appears and seems to be of a lusterless dirty hue, evidently also the seat of an inflammatory disturbance.

A secondary infection can be traced forward into the front end of the middle ventricle and along the anterior descending column of the fornix. On cutting through the cerebellum and the superior medullary velum exposing the corpora quadragemina and the floor of the fourth ventricle, it also presents the same dirty greenish appearance as above described.

In turning now to the corpus striatum on the right side, the infection seems to have extended pretty well out toward the lenticular nucleus and certainly has involved the fibres of the corona radiata in its outer aspect.

On cutting open the right optic thalamus and part of the right lenticular nucleus, the capsular fibres seem to be involved in their outer

half and certainly in the passage of the fibres from the capsule into the crus they have been markedly pressed upon by the abscess above mentioned and also no doubt involved in the inflammatory process. The two crura cerebri and the upper portion of the brain stem were saved for hardening in Miller's fluid to determine secondary degeneration.

The hemiplegia (think it was left) was due either to involvement of the pyramidal tract as it passed through the capsule interna or more probably to pressure of the abscess on the right crus. As said, the optic tract was not destroyed, but there may or may not have been symptoms on the part of the visual fields due to pressure.

REMARKS.

The case reported is another illustration of the fact that the right temporosphenoidal lobe may be the silent site of an abscess. Nearly ten years elapsed between the infliction of the injury and death. Immediately after the accident there were positive evidences of impairment of the internal capsule or of the pyramidal tract. It is likely that a hemorrhage slowly coming on by pressure caused the initial stupor and left-sided hemiparesis. With the gradual encapsulation of the clot, the focal pressure-symptoms disappeared. When the infection within the exudation occurred, it is impossible even to surmise. Although it is not without parallel elsewhere, it does seem very improbable that the infection which caused death had remained quiescent during nearly ten years.

Although the term "latent" might be used in the case reported, it would, in the light of subsequent events, be misused. I reluctantly quote from Mr. Ballance, "Is it not possible that in at least some of the latent cerebral cases, the latency has been in the faculties of the observer; not in the clinical reactions of the patient."

Had the patient been carefully observed at any time during the six months preceding death, it is practically certain that a lesion of the temporosphenoidal lobe would have been recognized and relieved by an operation. Before the paralysis supervened there were no symptoms except the general convulsions which were supposed to be the result of a brain scar, or due to the presence of the fragments of the bullet. My natural belief was that the convulsions were due to irritation

from the larger fragment which, on account of its position, had lodged near or within the cavernous sinus and could only be reached with the very greatest difficulty and danger to the patient. In the light of subsequent events I am certain that, had an operation been performed when the patient came under my observation in June, 1907, the abscess would have been at once encountered on opening the temporal fossa and the smaller fragment or real cause of the convulsions easily found. I am justified, I believe, in reporting this case as exemplifying an opportunity missed.

COMPLETE DETACHMENT OF THE FACIAL BONES FROM THE CRANIUM, TOGETHER WITH MULTIPLE FRACTURES OF THE SIDES AND BASE OF THE SKULL.*

RECOVERY. CONDITION AT THE END OF FOURTEEN MONTHS.

BY CHARLES A. POWERS, M.D.,

OF DENVER, COLO.,

THE following case is presented with brief comment. So far as I am able to ascertain, surgical literature presents no record of a similar injury followed by recovery.

Mrs. X., a lady of about 30 years, was thrown from her horse at 4.30 P.M. on March 27, 1908. It is probable that the horse fell on her head. She was seen by me twenty minutes after the accident, and at that time the following condition was noted. The patient was unconscious, the breathing was stertorous. The pulse was 70 per minute and of fair quality, the rectal temperature was 99°. There were moderate abrasions of the left side of the face. The patient was bleeding profusely from the nose and mouth; she was bleeding very freely from the right ear and moderately from the left ear. The face was greatly swollen and distorted. The orbital tissues were extremely swollen, protruded and ecchymosed. The features were in no way recognizable. On pressure the entire face could be freely moved from side to side and from above downward. On pressing the lower jaw against the upper jaw the face and orbital tissues showed upward. No injuries were found excepting those of the head.

Diagnosis: Detachment of the facial bones from the cranium with fractures of the base of the skull. Prognosis, very grave.

Immediate and thorough cleansing was made of both ears: the auditory canals were moderately packed with sterile gauze and copious aseptic dressings applied. The nasal fossæ were cleansed as well as possible and packed with iodoform gauze. The pharynx was washed and sprayed.

During the evening the pulse and temperature began to rise.

* Read before the American Surgical Association, June 6, 1909.

The urine contained a moderate amount of albumin. Copious infusions of salt solution were ordered. Late in the evening the patient made a semi-response to questions. Examination of the pupils directly after the accident and during the evening showed them to be equal, moderately contracted, responding to light.

The following morning at nine o'clock the temperature was 106°, the pulse 150 and thready. Infusions of salt solution were liberally used. During the forenoon the patient replied to questions in a semi-intelligent way. During the day the temperature and pulse fell; at eight P.M. the temperature was 102°, the pulse 120. The following morning, the morning of March 29, the temperature was 100°, the pulse 90. During the time which had elapsed since the accident there had been pretty free bleeding from the right ear and moderate bleeding from the left ear. Scrupulous asepsis was maintained in the necessary change of dressings. The hemorrhage from the nose and pharynx practically ceased at about the end of twenty-four hours and frequent sprays of a boric solution were used.

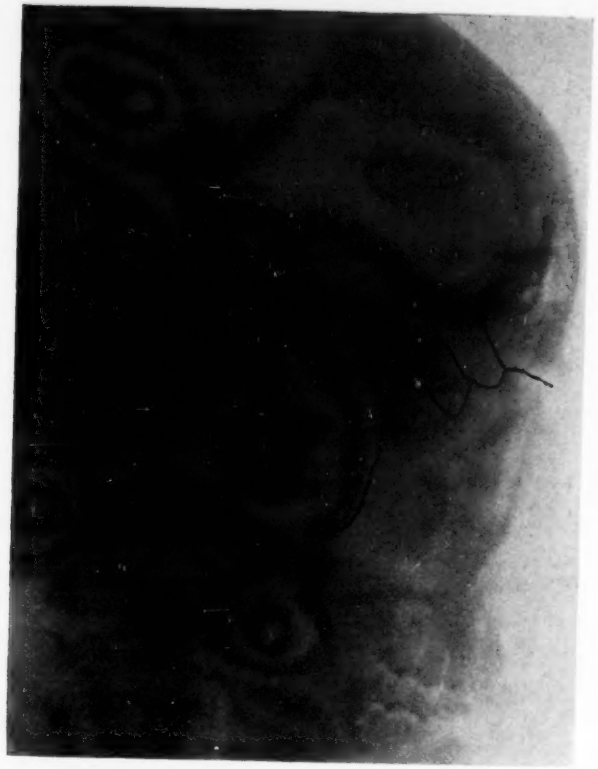
During the next few days the temperature averaged about 100°, the pulse was from 90 to 100, the mental attitude seemed to gradually improve and it was fair to assume that a condition of concussion of the brain rather than of compression had been present. At no time was there any paralysis of the extremities, the reflexes had been preserved. Forty-eight hours after the accident gentle attempts were made to mould the facial bones into place and these efforts were repeated from day to day. No retentive apparatus was thought advisable. The lower jaw seemed uninjured.

Four days after the accident skiagrams were taken by Dr. Childs. They are reproduced in Figures 1 and 2. There are doubtless other lesser fracture lines in addition to those shown. Dr. Childs's description of them is as follows:

"The skiagrams of Mrs. X., taken April 1, 1908, show the following conditions:

"A complete transverse fracture of the nasal bones 9 mm. distal to their articulation with the frontal bone, the fracture extending through the ethmoid and nasal process of the maxilla into either orbit. In the left orbit the fracture can be traced across the orbital plate of the maxilla and emerges near the external orbital process, thence is continued downward through the

FIG. 1.



Complete detachment of the facial bones from the cranium, multiple fractures of the sides and base of the skull. Right side. (Skiagram and tracing by Dr. Childs.)

FIG. 2.

Complete detachment of the facial bones from the cranium, multiple fractures of the sides and base of the skull. Left side. (Skiagram and tracing by Dr. Childs.)

tip of the zygoma at its junction with the malar bone, then passes backward and downward through the maxilla and pterygoid plate of the sphenoid, terminating 6 mm. above the level of the inferior surface of the palate bone. About midway of the left orbit there is a branching line of fracture which can be traced upward through the orbit into the frontal bone.

"In the right orbit there is a stellate fracture, one limb of which passes upward through the orbital plate of the frontal and a lower limb passes across the orbit, thence through the malar bone, continuing its course downward and backward through the maxilla and pterygoid plate of the sphenoid, terminating just above the level of the inferior surface of the palate bone.

"At the base of the skull there is a fracture extending backward from the petrous portion of the temporal into the occipital bone.

"*Diagnosis:* Complete transverse fracture of the bones in the upper part of the face, with basal fractures of the frontal, temporal and occipital bones."

On the sixth day the patient experienced a moderate chill followed by increased temperature and gradually lost the sight of the right eye. This was thought to be due to a compression of the optic nerve. Dr. J. M. Foster,[1] who assumed the care of the eyes shortly afterward, kindly gives me, under date of May 3, 1909, the following from his notes:

"I first saw Mrs. X. on the ninth day after the accident, April 4, 1908, at which time the swelling of the lids had greatly decreased, but she was unable to voluntarily raise the lids. The sight had apparently remained good in each eye until the evening of the sixth day when she noticed diminution in the left. This was accompanied by increase in temperature, rigor, and sweating. On the morning of the seventh day she was unable to see a lighted candle with the left eye. There was complete ptosis of the right side, but on the left it was not quite so marked. No facial paralysis. Conjunctiva was congested, slight mucous secretion. Each eye-ball was absolutely fixed, no motion in any direction, marked bulging outward. The pupils were slightly dilated, the right sluggish, the left immovable. The right disc was slightly blurred on the edges, vessels normal. There was a

[1] I am also indebted to Drs. Pershing, Bonney and Jayne for kind aid in the care of the patient.

grayish pallor over the entire retina. The left disc was quite pale, vessels contracted, especially the arteries, and grayish color around the disc and the macula. No effusion nor cherry red spot. At this time it seemed probable that the condition was the result of pressure upon the blood-vessels and nerves at their entrance to the orbit, less probably due to an embolism of the arteria centralis retinæ. V.R. 20/80, V.L. nil.

"April 27, 1908. Examination showed that the condition of the right eye was practically unchanged except that the internal rectus showed slight inclination to turn the ball somewhat inward and the ptosis was less pronounced. The movements of the left eye were good in all directions and the ophthalmoscope showed a typical picture of atrophy of the optic nerve.

"On May 8, 1908, the condition continued to improve as far as the movements of the left eye were concerned. There was very little ptosis remaining and the eye moved readily in all directions. The right eye, however, had made but little change. Ptosis had improved somewhat and the power of the internal rectus was slightly greater. Vision equalled 20/70.

"On July 17, after having used the galvanic current applied directly to the muscular attachments on the right eye the past three weeks, it is found that the internal rectus and the superior and inferior recti muscles are regaining some strength, but the external is absolutely without function. V.R. equals 20/40 with .25 = −1 C. 180. = 20/30. V.L. nil.

"April 18, 1909. The ptosis of the right eye is almost overcome, but there is still slight drooping of the lid and the internal rectus has pulled the right eye into the inner angle for the past six months producing very pronounced paralytic squint. The superior and inferior recti have only regained a small portion of their normal strength. The external rectus remains paralyzed. Tenotomy of the internal rectus * followed by shortening and advancement of the right external rectus brings the eye to primary position. The hearing in each ear is normal for voice, whisper and watch."

After the first few days the patient gradually underwent improvement. She never complained of pain, she was able to be nourished, the bowels gave no trouble. At times there was a trace of albumin in the urine, at other times urine was free from this. There was a moderate cerebrospinal discharge from the

left ear for a few days and a considerable similar discharge from the right ear for many days. In due course of time this completely ceased. The hearing remained good and has never been impaired. It was about two weeks before recent events became fixed in the memory.

As has been said, the facial bones were gently and carefully moulded into place. They underwent complete union at the end of five weeks. Resultant deformity is but very slight. The face is a very little dropped, the distance between the tip of the nose and the forehead is a little increased. The nose is in a straight line. There is a little prominence of the left malar bone. Articulation between the left lower and upper teeth is not quite perfect. There is perfect articulation on the right side.

Mrs. X. gradually became restored to practically complete health. At this time, fourteen months after the accident, aside from the disability of the eyes, before noted, she is in a practically normal condition.

A thorough search of surgical literature, in which quest I have had the kind aid of Dr. F. Robbins, of New York, fails to reveal a parallel case. The only observation definitely bearing on the subject which we have been able to find is the following by La Personne and Le Fort in *La Presse Médicale*, No. lxii, 1900:

Their patient was a man 26 years of age who met with an accident in such a way that his face was thrust on the ground and his head held fast for several minutes under a heavy stone. Details of the accident were not remembered by the patient, although he claimed not to have become unconscious. There were a few insignificant abrasions of the hairy scalp, while the face had borne the brunt of the injury. The nasal bones, the upper jaws, and the right inferior maxilla were separated from the remaining bones and the upper jaws could be moved from side to side and from above downward, under crepitation. In spite of these severe injuries the face healed, but not without considerable deformity, which caused the patient to seek admission to the hospital. Numerous bluish-black scars were seen surrounding the right eye; the orbit was much contracted and the eyeball was adherent to the conjunctiva on the outer side; there was paralysis of the right external rectus muscle, and internal strabismus. The root of the nose was enlarged and pushed over to the right; the right superior maxilla was flattened and sunken; there was slight facial paralysis. The lower margin of the orbit was broken through and the inner portion was 2–3 mm. lower than the outer. The skin in the region of the outer side of the upper jaw was anæsthetic.

By means of plastic procedures the patient's condition was much

improved and the cosmetic deformity was corrected to a considerable extent. Ten days after the operation he asked to be discharged from the hospital, and six weeks later he was described as free from pain and having a wider palpebral slit, which began to show the eye-ball at the inner angle in spite of the marked internal strabismus.

La Personne and Le Fort say that this observation gives rise to a number of interesting questions. There were several complicated fractures and paralyses, the retrospective diagnosis of which is by no means easy. Beyond a doubt there was a large fracture involving the two superior maxillæ, separating their entire lower portion from the higher parts and the overlying bones; this transverse fracture separated the entire palatine arch from the remainder of the face. The pterygoid processes were in all probability broken off at the base and mobilized with the palatine arch, as is the rule in these fractures. The right malar bone was detached above at the level of its articulation with the frontal bone; outside, at the level of the xygomatic arch; within, it was separated from the superior maxilla; downwards and backwards, it remained adherent to the pyramid, which was shattered and penetrated in part into the maxillary sinus. Thus the malar bone, with the outer angle of the pyramid formed a second fragment, which underwent a to-and-fro motion causing the sinus wall to be pushed up from below. A third fragment was loosened in shape of the entire ascending ramus of the right maxillary, which became crowded upward into the orbit. This displacement led to very serious results: outward deviation of the palpebral slit and complete destruction of the nasal canal. It is very probable that the bones of the nose were fractured with the base of their frontal insertion, a very rare and extremely grave lesion. Moreover, there seems to have been a luxation of the right nasal bone on the ascending process of the maxillary bone of the same side, a luxation which is practically certain to be complicated by fracture. The lesions at the left orbital margin and the anæsthesia in the left suborbital region, serve to show that there was a fracture on this side; it is probable that there were lesions of a minor degree, but about symmetrical with those of the right side, in the region of the left malar bone.

THE PARATHYROID QUESTION.*

BY CHARLES H. MAYO, M.D.,

OF ROCHESTER, MINNESOTA,

Surgeon to St. Mary's Hospital.

For more than fifty years reference has been made by various authors to peculiar gland bodies that were quite regularly associated or connected with the thyroid glands.

Sandstrom's [1] excellent description of what he called "accessory thyroids" was given in 1880, and Gley [2] demonstrated later that tetany was caused by the removal of these glands in thyroidectomy. Rogowitz,[3] Christiani,[4] Zielenska,[5] and Hürthle [6] respectively described as embryonic thyroids similar bodies in various animals.

In 1895, Kohn [7] made note of four epithelial capsules to the individual, although more, or fewer have been noted occasionally.

In 1908, Welsh [8] gave us an exhaustive description of the parathyroids which he designated as, posterior superior and anterior inferior.

Moussu,[9] Vassale and Generali,[10] and Jeandelize believed that a deficiency of parathyroid secretion occurred in exophthalmic goitre, and they, with others, thought the same condition was the probable cause of various forms of convulsions.

Lundberg [12] believed that paralysis agitans was also caused by a deficiency of secretion, his theory being shown by Thompson [13] as erroneous in an examination of nine cases at autopsy. Thompson's statement is supported by other investigators.

As stated by the more careful observers, the parathyroid glands are four in number, usually without the true capsule of the thyroid gland. They are 6 or 7 mm. long, 3 to 4 mm. wide and 2.5 mm. thick. They are supplied by a terminal

* Read before the American Surgical Association, June 4, 1909.

artery entering the hilus. The arterial supply is mostly derived from the inferior thyroid artery, or from the anastomotic branch between the superior and inferior thyroid arteries. The parathyroid glands are often designated as *superior* or *external,* and *inferior* or *internal.*

There are wide variations in the effect of the removal of the parathyroids in various animals, especially the herbivorous animals, in whom the bodies may be irregularly placed at a distance from or within the thyroid, making it difficult to be positive as to their complete removal. Extirpation of the parathyroids of animals, especially in dogs, is quite regularly followed by tetany.

The association of function of the glands like the thyroid, parathyroid, thymus, suprarenal and others become more marked as continued investigation discloses the various changes consequent to disease or removal of the various glands. It is probable that some of the glands act through the hormones or chemical messengers, and that others are more reflex in effect. MacCallum and Voegtlin [14] especially mark the changes in calcium metabolism incident to parathyroid deficiency.

The pathologic changes are of simple types, *i.e.,* degenerations, hemorrhages, cysts, and seldom tumors. There are about a dozen tumors of the parathyroid reported, most of these being found at autopsy, and all were benign adenomas.

From such reports it would appear that these glands as compared with other organs and lesions are singularly free from serious diseases, especially those of a surgical nature. This explains why our information is gained principally from accidental findings incident to their injury during operation upon associated structures and from direct experimental work upon animals, thereby differing from the more recent medical advances.

The greatest progress in our working knowledge of the pathology of the body in general has come from the treatment of surgical conditions, and from a consideration of pathologic changes in the living.

In the surgery of the thyroid, not considering sepsis, we have always had reason to fear hemorrhage both primary and secondary, as well as injury to the recurrent laryngeal nerves. Must we not be watchful of the parathyroids? While the deaths from their injury will probably be fewer than those from the first mentioned condition, the character of the death with convulsive seizures seems more shocking than from any other cause.

In 1200 operations for goitre we have seen no tetany, and it is possible that certain principles of operation which were developed long before there was a parathyroid question, may have contributed to the preservation of the parathyroid bodies.

Freedom from hemorrhage, *i.e.*, a bloodless operation, has not been a marked feature, as the superior thyroid artery is usually the only large vessel ligated as it enters the gland. Other vessels are caught by many forceps as they pass through the capsule. The posterior capsule is carefully preserved in all operations upon the thyroid. We believe this technic best for the occasional or inexperienced operator, but possibly not necessary for the experienced surgeon who continuously maintains a dry wound. Cystic tumors or encapsulated adenomas are usually treated by the Partia-Socin-Billroth method of enucleation. Large colloid growths are treated by extirpation of the larger lobe and resection of the other side. When the enlargement is marked and nearly even, resection on both sides, as advocated by Mikulicz, is an excellent method of reduction.

Operations upon cases of hyperthyroidism are usually confined to one side, and the blood supply being free, there is but little danger of subsequent hypoparathyroidism.

As the removal of supposed lymph glands or small accessory thyroids is not essential in operation for goitre, we make it a rule to implant such bodies, when accidentally removed, into the capsule of the remaining lobe or in some other acceptable location in the exposed tissue of the neck. It is quite possible that the human being with four parathyroids

has some to spare, and that if those on one side are preserved, no untoward consequences will follow. This phenomenon has been noted in other double structures, the kidneys, ovaries, etc. In four instances in which one parathyroid body was removed we noted no unusual symptoms during recovery.

Should tetany follow an operation for the removal of the goitres, the indications are to administer calcium salts, preferably the lactate, in 4 to 5 per cent. solution intravenously, by stomach, or by rectal enemata. This has been found most efficient in dogs, by Voegtlin and MacCallum, although Beebe and Berkeley [15] in a similar series of cases of experimental tetany were not so favorably impressed with the efficacy of the calcium as with the use of their parathyroid serum.

In experimental tetany, bleeding seems to be of temporary benefit, but it is probable that in most human beings in which it occurs, that the operation will have served that purpose.

If the above remedies can but maintain life until parathyroid glands can be secured, transplanted and function obtained, it may be possible to tide the patient over into a chronic state which may later become a cure.

In a report of cases and of experimental work, Halsted [16] reports having secured benefit not only from the use of serum, but from feeding both dried and fresh beeves parathyroids. He found it necessary, in order to secure the success of the transplanting of the parathyroids, to first cause a parathyroid deficiency. While he obtains the best results by implanting the glands beneath the posterior sheath of the rectus abdominus, others have apparently succeeded by grafts into the remaining lobe of the thyroid, into the spleen, peritoneum and other locations.

BIBLIOGRAPHY.

[1] Sandstrom: Lakereförenings Förhandlingar, Upsala, 1880.
[2] Gley: Comptes Rendus de la Soc. de Biol., 1891-95-97.
[3] Rogowitz: Arch. de Phys. Nor. et Path., 1888.
[4] Christiani: Arch. de Phys. Nor. et Path., 1893.
[5] Zielenski: Virchow's Arch., cxxxvi, 170, 1894.
[6] Hürthle: Arch. f. die gesammte Phys., lvi, 1, 1894.
[7] Kohn: Archiv. f. mik. Anat., xliv, 366, 1895.

[8] Welsh: Jour. of Anat. and Phys., xxxii, 292–380, 1898.
[9] Moussu: Comptes Rendus de la Soc. de Biol., No. 2 and 3, 1897.
[10] Vassale and Generali: Revista de Path. nerv. e mentali, c and ccxciv, 1896.
[11] Jeandelize-Lundberg: Zeit. f. Nervenheil-Kunde, xxvii, H. 5–4 217, 1904.
[12] Lundberg: Deut. Zeit. f. Nervenheil-Kunde, xxvii, p. 743, 1904.
[13] Thompson and Harris: Jour. Med. Research, July, 1908.
[14] MacCallum and Voegtlin: Johns Hopkins Hosp. Bulletin, March, 1908.
[15] Beebe and Berkeley: Proc. of the Soc. for Exper. Biol. and Med., iv, j. 64, 'o 64, 1907.
[16] Halsted: Am. Jour. Med. Sciences, July, 1907. ANNALS OF SURGERY, Oct., 1907. Soc. Exper. Biol. and Med., 1908.

THE HISTOPATHOLOGY OF GOITRE.

BASED UPON THE MICROSCOPICAL STUDY OF OVER FIFTY CASES OF THYROIDECTOMY, WITH HISTORIES OF THE MOST IMPORTANT.*

BY FRANCIS J. SHEPHERD, M.D.,

AND

C. W. DUVAL, M.D.,

OF MONTREAL, CANADA.

MacCallum, of Baltimore, in a recent article on the pathology of exophthalmic goitre, describes certain histological changes in the thyroid gland which he regards as diagnostic of the disease. These microscopic changes he depicts as a budding or infolding of the acinal epithelium, together with certain alterations in the morphological character of the lining cells. His observations were made upon a number of cases of exophthalmic goitre, every one of them presenting the characteristic picture to a greater or less degree. Even in the very early stages of the disease the histopathological change could be made out in some part of the gland.

In view of this work we were led to make a careful comparative study of fifty or more consecutive cases of thyroid conditions, including all varieties of gland disturbances and without special reference to Graves's disease. In this way we considered it possible to ascertain whether any pathological picture characterizes the thyroid gland in exophthalmic goitre distinctively from other conditions.

Fifty-nine cases in all were carefully studied histologically. Eighteen cases were unquestionably Graves's disease, two of which proved fatal. The infolding and budding of the acinal epithelium was present in some parts of the gland in 20 cases. The gland presented tumor formation in three cases of the series, viz.: carcinoma in one, intercystic papilloma in another, and angioma in still another. Chronic inflammation in the

* Read before the American Surgical Association, June 4, 1909.

form of lymphoid- and plasma-cell infiltration, together with an increase in fibrous-tissue stroma, occurred 29 times. Eleven cases were of a simple cystic condition. In each case many sections were obtained for microscopic study and from various parts of the gland. The tissue was fixed in Zenker's fluid, formalin, and alcohol, and embedded in paraffin. Sections were stained in eosinomethylene blue, hæmatoxylin-eosin, and Mallory's connective-tissue stain.

For convenience of description the histopathological changes that occurred in this series of thyroid glands may be divided into six groups:

The *first* type is characterized by a subacute inflammation in which the supporting framework of connective tissue is infiltrated with lymphoid and plasma cells. The cellular exudate is usually focal, though sometimes it is diffusely distributed throughout the interacinal tissue.

The *second* type of lesion is distinctly proliferative in character; the connective-tissue trabeculæ and acinal framework are markedly increased. This fibrous new growth presents the essential change. Often dense foci of leucocytes, including plasma and lymphoid cells and polynuclear neutrophiles, infiltrate the areas of connective tissue. One of the striking features in this type of chronic thyroiditis is the occurrence of sharply defined collections of cells whose architecture resembles the so-called " tracoma bodies," or even the lymph nodes. Encircling these bodies are dense collections of mononuclear lymphocytes. The cells comprising these bodies are 10–12 microns in diameter and possess a single ovoid vesicular nucleus and pale-staining granular protoplasm. Whether the cells are of endothelial origin cannot be definitely stated, though in our opinion it would seem to be the explanation.

The *third* type of lesion is characterized by vascular changes. These usually take the form of an obliterating endarteritis, though in some vessels the lesion appears as a degeneration especially of the media. Thrombosis is occasionally seen. There is often associated with the vascular changes a well-marked perivascular increase in fibrous tissue. With this

type of lesion hemorrhage into the acini is frequently encountered. The most interesting change, however, occurs in the gland epithelium. Here large areas of the parenchyma undergo necrosis, but the individual cells lining the alveoli remain intact; the picture is analogous to an extensive focal necrosis of the liver. The destruction undoubtedly results from occlusion of the vessel supplying a particular area, in which the occlusion is either endarteritic, thrombotic, or both.

A *fourth* group of changes includes the neoplasms, such as carcinoma, intercystic papilloma, and angioma.

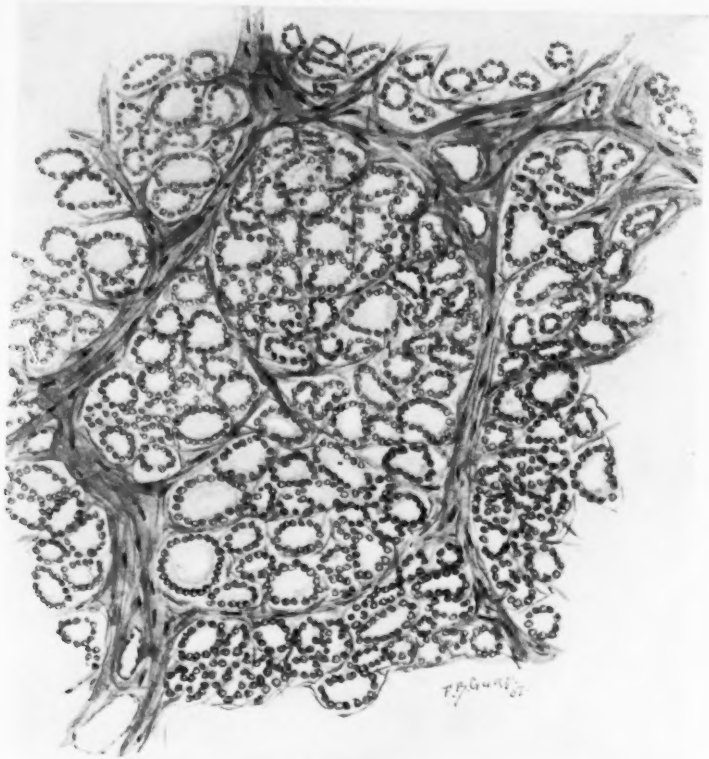
The *fifth* type consists of an interstitial cellular (interacinal) hyperplasia which in many ways resembles a sarcomatous growth. Though the acini are apparently unchanged in size and structure they are uniformly separated by the enormous cellular increase in the tissues interposed.

The *sixth* type is represented by distinct hyperplasia of the gland parenchyma, which results in more or less tortuosity of the alveoli and infolding of the epithelium, the degree largely dependent upon the amount of colloid substance within the lumen.

The microscopic study of a large number of sections from each specimen of gland showed neither cellular arrangement nor cytological changes ordinarily detected by routine staining methods which could be regarded as specific for any special type of disease of the thyroid gland. Though infolding and budding of the acinal epithelium occurred in the gland of exophthalmic disease, the histological picture, however, was not at all constant. Occasionally infolding of the alveoli is entirely absent in unquestionable cases of Graves's disease; while, on the other hand, infolding and budding of the alveolar wall frequently occurs in simple goitre and other benign conditions of the thyroid gland in which there is hyperplasia.

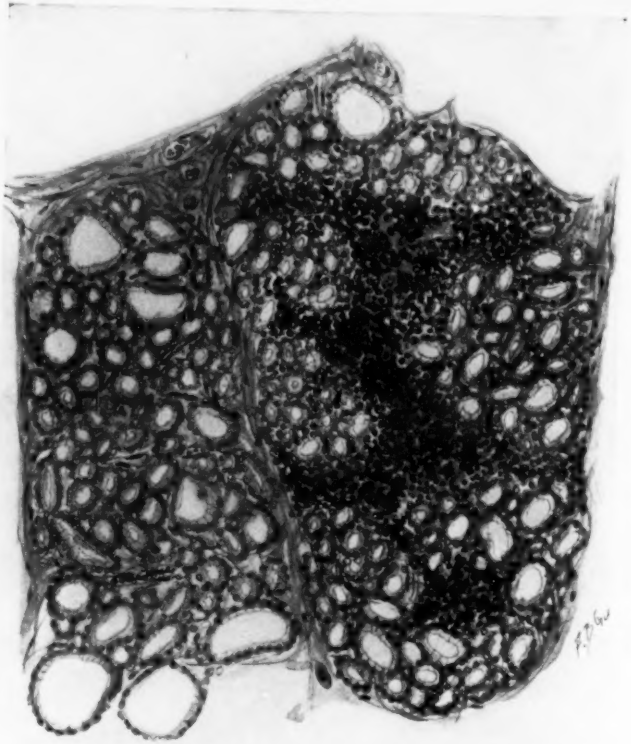
In our series of examinations five pronounced cases of Graves's disease failed to show the slightest suggestion of infolding of the gland epithelium, though many sections and from all parts of the specimen, were examined. Again, in our cases we encountered a number of cystic goitres and glands,

FIG. 1.



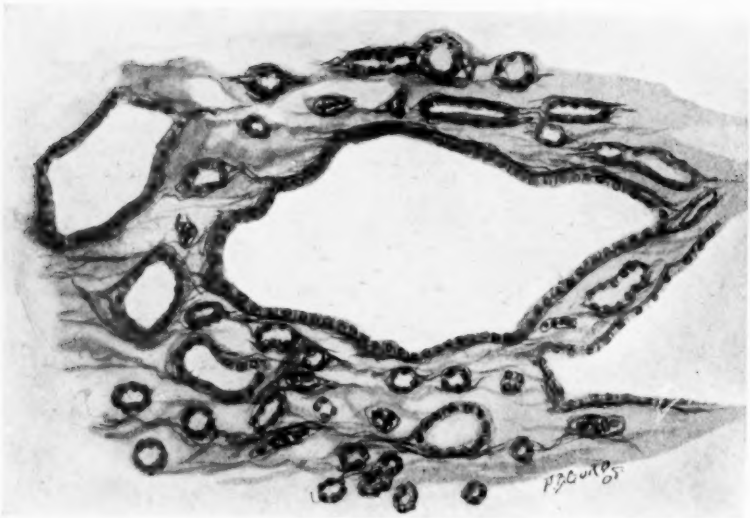
Normal thyroid gland.

FIG. 2.



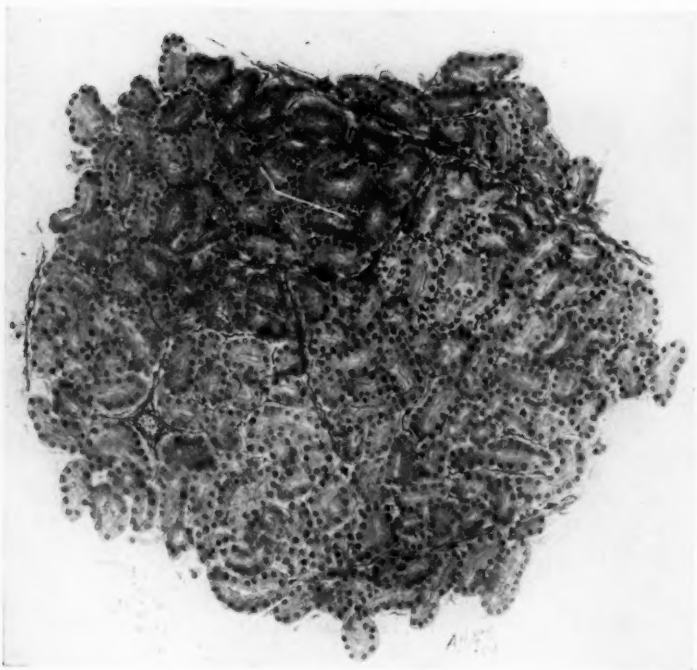
Chronic inflammatory globule infiltrated with lymphoid cells.

FIG. 3.



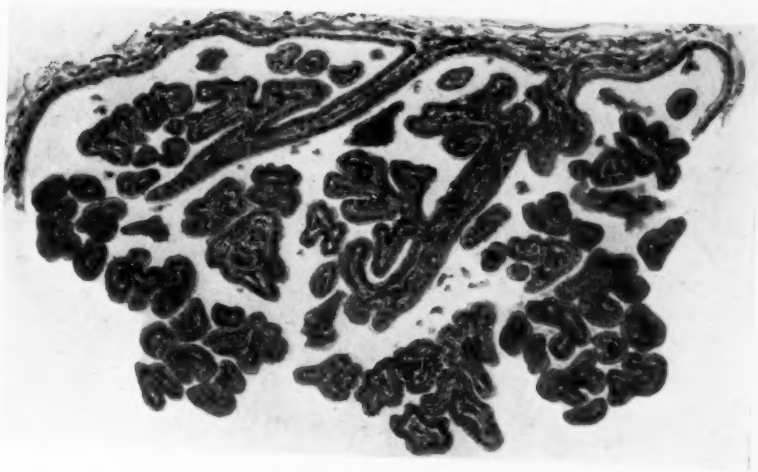
Cystic thyroiditis.

FIG. 4.



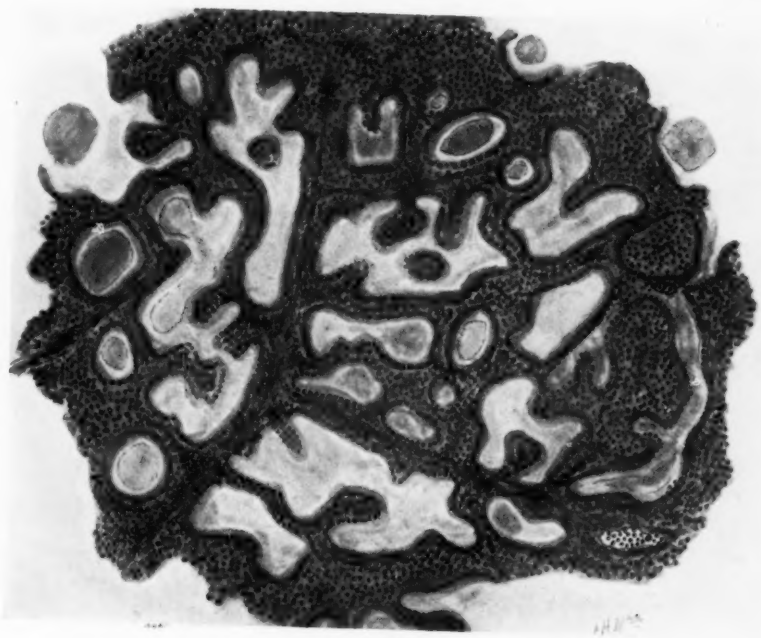
Adenocarcinoma.

FIG. 5.



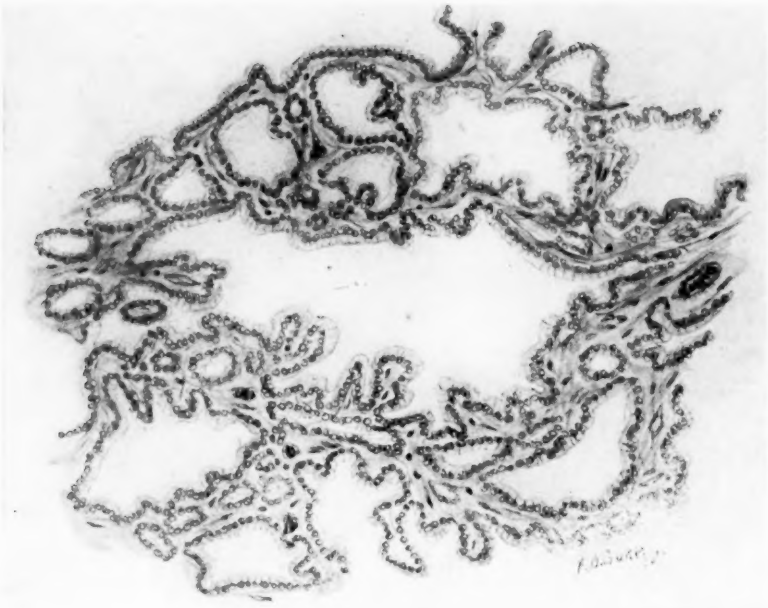
Intracystic papilloma.

FIG. 6.



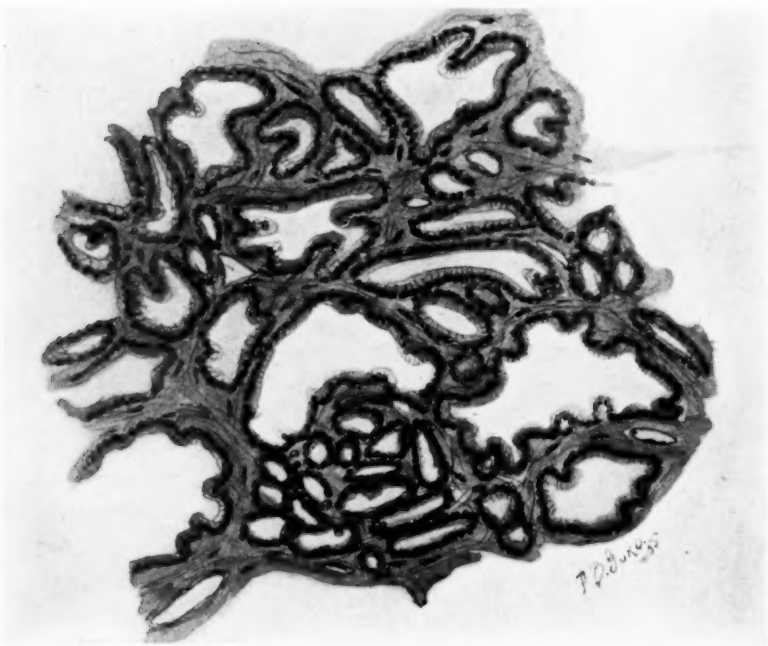
Interacinal hyperplasia.

FIG. 7.



Marked glandular hyperplasia, showing infolding and budding of the acini. *Not* a case of exophthalmic goitre.

FIG. 8.



Slight hyperplasia (infolding and budding). Fatal case of exophthalmic goitre; not operated upon.

the seat of extensive neoplastic growth, that presented the perfectly typical picture of infolding and budding of the parenchymal cells.

Alterations in the morphological character of the epithelium—for example, several layers of cells lining the alveolar walls, the flattened type of cell becoming columnar, the change in chromatin-content of the nuclei, etc.—we have not found constant for any one pathological condition of the thyroid gland. Whether the lining epithelium of the gland is columnar or flattened depends upon the amount of colloid material within the lumen. It is noteworthy, in parts of the glands that show distinct histological changes of a hyperplastic nature, to find a marked diminution of the amount of colloid; very often there is an apparent absence of this material. Though the epithelium shows no appreciable microscopical alteration in cell morphology, there is undoubtedly a decided change in cell function as evidenced by the lack of colloid production. The absence of acinal contents naturally permits of a columnar type of cell lining.

Only rarely in thyroid hyperplasia were we able to detect more than two layers of epithelial cells lining the acini. Not even in the extreme grade of exophthalmic goitre were the cells heaped up. Often what appeared as several layers of "focal budding" could be explained by the fact that the knife had sectioned the gland alveoli at various places.

Infolding of the epithelium may occur in any thyroid gland when active hypertrophy is going on, especially in the absence of colloid production, no matter what the cause. The same fundamental principle governing the phenomena is also met with in other glandular organs which are the seat of hypertrophy; for example, the prostate, where the infolding is sometimes beautifully illustrated.

In some instances three or more of the above described types of lesions occur in the same gland, while in others the histological change is confined to one type. It is especially notewothy in the gland of exophthalmic disease to find multiple lesions, widely separated and distinctive in character, though

the lesion may be single and confined to one area and without histological variation.

The following cases are detailed in illustration of our findings:

CASES OF TRUE GRAVES'S DISEASE WITHOUT ANY INFOLDING AND BUDDING OF THE EPITHELIUM, WITH OR WITHOUT MUCH INCREASE IN CONNECTIVE TISSUE.

CASE I.—Miss G., aged 29. Has had a slightly enlarged neck for some years; on examination only a small nodule can be felt above the sternum. Is excessively nervous, has tachycardia (pulse 100–120), tremors, marked exophthalmos. Operation: removed two large lobes situated beneath the sternum. Microscopic examination shows no infolding or budding of the epithelium, but there was a cystic condition and acini filled with colloid, some increase of connective tissue which contains collections of lymphoid and plasma cells; and some interstitial hemorrhage.

CASE II.—Miss B., aged 38. Had been treated in the medical wards of the Montreal General Hospital for six months for a very severe form of Graves's disease. Tachycardia (130–140), tremors, exophthalmos, dilated right heart, extreme emaciation, etc. Removed most of a not very large thyroid and ligated all the vessels; and yet the microscopic examination showed no infolding and budding of epithelium, but much colloid and slight increase of connective tissue.

CASE III.—Miss C., aged 24. Some years ago noticed a small lump in the thyroid. At the same time got excessively nervous, pulse ranged from 130–140, with marked palpitation. When I saw her she had an enlarged thyroid, tremors, slight exophthalmos, Stellwag's sign, pulse 130, breathlessness, unable to go upstairs. Removed the right lobe and isthmus and tied all the thyroids. After operation marked thyroidism for twenty-four hours. On microscopic examination no infolding or budding of epithelium found, but much colloid and some increase of connective tissue.

CASE IV.—Henry H., aged 53. Great nervousness, tachycardia, tremors, emaciation, Stellwag's sign, commencing enlargement of right heart. On microscopical examination found no infolding of epithelium but very small acini, intra-acinal hemorrhage, and the gland markedly cystic in many places.

CASE V.—Miss P. B., aged 25. For two years had been excessively nervous, but no enlargement of the thyroid gland. Then enlargement was noticed and at the same time her eyes became prominent. Became unfit for her work of teaching and consulted Dr. Shepherd. At this time it was noted that she had considerable enlargement of both lobes of the thyroid, which were soft and vascular. Eyes very prominent and both Stellwag's and Graefe's signs present. Excessive nervousness, tremors, loss of flesh, with tachycardia (130–140), breathlessness. She also had temperature and some swelling of legs. The right heart was moderately distended. The case was one of well-marked Graves's disease, and she was admitted to the Hospital and treated medically for some weeks. At her earnest request an operation was performed and the right lobe of the thyroid and the isthmus removed; the left superior thyroid was tied. She did well for twelve hours, when her pulse became uncountable; she was excessively nervous, tossing about the bed, and soon became delirious and died twenty-four hours after operation. Her temperature never rose above 99.5°. The microscopic examination showed no infolding or budding of epithelium, but the acini were much increased and distended with colloid and the epithelium lining them was flattened.

CASES WITH MARKED INFOLDING AND BUDDING OF EPITHELIUM OF THE GLAND AND YET NO GRAVES'S DISEASE.

CASE I.—Mrs. B., aged 33. For many years had an enlargement of the neck on right side; at times larger than at others. Some two months before seeing her it had grown very rapidly. On examination was found a round, smooth tumor of the right lobe of the thyroid the size of a Tangerine orange; did not extend below the bony thorax, and appeared to be a large tense cyst. No tachycardia, no tremors, no exophthalmos, and no difficulty in breathing or swallowing; evidently a very nervous woman. Removed right lobe of thyroid which contained one large cyst and several small ones.

CASE II.—Miss H., aged 25. Has had a swelling of neck since she was 16 years old; tumor in mid-line. Has never grown rapidly. Has some breathlessness on exertion and attacks of dyspnœa, no tremors, no exophthalmos; pulse 90; considerable dysphagia at times when solids are taken. Operation: removed

an adenoma by enucleation. All symptoms relieved. In addition to infolding there was chronic inflammation and increase in connective tissue.

CASE III.—Mrs. D., aged 54. Two years ago noticed a small lump on the left lobe of the thyroid; has grown rapidly. On examination found one large and one small tumor in left lobe, largest, size of a large orange and other of a walnut, evidently cystic. No tachycardia, no tremors, no exophthalmos, no evidence of Graves's disease; pulse 80. Operation: removed left lobe and isthmus. In this case there was, in addition to the infolding and budding of epithelium, chronic inflammation with a lot of lymphoid and plasma cells and considerable colloid; no increase in connective tissue.

CASE IV.—Mrs. E., aged 39. For ten years had general enlargement of the thyroid, commenced when carrying first child. No tremors, no nervousness or ocular symptoms. Difficulty in swallowing; pulse 84. Hypertrophy and dilatation of epithelium; infolding and budding and much hyperplasia.

CASE V.—Miss F., aged 28. Has had "swelling of throat" for eight or nine years, which of late has caused some difficulty in breathing. Has taken thyroid extract with benefit. Of late the goitre has been increasing rapidly. On examination found an evenly enlarged thyroid, soft and vascular; pulse 98. No exophthalmos, no tremors, but only complains of breathlessness on exertion. Examination by larynx revealed pressure on the right side of the trachea opposite the fourth to the seventh rings of the trachea. Right lobe and isthmus removed. Much relieved by operation and was practically well six months later. Microscopic examination showed infolding of acinal epithelium in places and much hyperplasia; in others acini dilated with colloid and flattened epithelium.

CASE VI.—Miss A. H., aged 26. Six years ago noticed a small lump on the right side of the neck; grew very little until a few months before admission to Hospital under Dr. Bazin. Lately has been troubled with difficulty in swallowing and shortness of breath on exertion. Growth on right side and size of a goose egg. Pulse 78. No tremors, no exophthalmos or nervousness, absolutely no signs of Graves's disease. The growth was removed and on microscopical examination showed well-marked infolding and budding of acinal epithelium, with large areas of

increased connective tissue and diminution of colloid. In some parts there was acinal dilatation.

CASE VII.—Mrs. O., aged 40. Has had for some years a cyst of the thyroid which has been constantly increasing in size and from the discomfort and difficulty of breathing caused she desired operation. There were no nervous symptoms, no tachycardia, no tremors, in fact no symptoms indicative of Graves's disease. Dr. Elder removed the cyst by enucleation and she recovered rapidly. The microscopic appearance showed well-marked infolding and budding of the epithelium of the acini.

CASE VIII.—*Graves's disease with typical infolding, etc., in the right half of gland, which was first removed. Later great increase of left lobe with return of symptoms. This on removal showed no infolding of epithelium but merely acini distended with colloid and lined with flattened epithelium.*

Miss R. R., aged 23. For four years had suffered from symptoms of Graves's disease which came on with enlargement of the thyroid. Had tachycardia, tremors, nervousness, vomiting, high temperature, great exophthalmos, and enlargement of the right heart. Was in New York at the time and had the thyroids tied in one of the large hospitals, but secured no benefit from this treatment. In October, 1908, the right half of the thyroid was removed at the Montreal General Hospital with great benefit. The pulse was reduced to below 100, nervousness was less, and she was in every way better and able to return to her work. In the beginning of 1909, the left side of the gland began to enlarge rapidly and all the old symptoms returned. On admission to the Hospital in April, 1909, she seemed to be as bad as before the operation in 1908; in addition she had dilatation of the right pupil. The left half of the gland was removed, only a small piece being left on the trachea. She rapidly recovered from the operation and a month later all the symptoms had been much alleviated. The exophthalmos had disappeared from the right eye and the pupil was normal in size. The exophthalmos of the left eye, however, was as marked as ever. The microscopic appearance of the portion of gland first removed showed well-marked infolding and budding of the epithelium in the acini. The gland removed at the second operation showed no infolding of budding of the epithelium but merely acini lined with flattened epithelium and full of colloid.

EXCISION OF THE LARYNX FOR CARCINOMA.*

BY JAMES BELL, M.D.,

OF MONTREAL,

Professor of Surgery in McGill University; Surgeon to the Royal Victoria Hospital.

JUDGING from the contributions on this subject which one finds in surgical literature in the English language, it appears to me that the operative treatment of malignant disease of the larynx has received much less attention from English and American surgeons than it has deserved.

My own experience in this field has been limited to twelve complete laryngectomies and three thyrotomies with intralaryngeal operation; and while the results have been far from brilliant they have been to me very instructive and very encouraging. In this communication I shall speak only of the twelve complete laryngectomies, as the partial operations were not satisfactory, and, in fact, were not well chosen.

My limited experience has shown me that the technical difficulties of the operation and the danger from interference with respiration during operation are much less than one would "*a priori*" expect, and also that the great postoperative danger, justly so much dreaded in extensive operations involving the pharynx, aspiration pneumonia, may be entirely or almost entirely avoided by attention to the posture of the patient during and after operation. This latter point has been strongly insisted upon by Gluck, whose results have been almost phenomenal. Compared, for example, with extensive operations upon the tongue for cancer, I believe that extirpation of the larynx is a much simpler and safer operation, with much less postoperative danger and much less danger of recurrence, as well as an operation which gives a much better functional result.

In intrinsic laryngeal cancer the cartilaginous framework

* Read before the American Surgical Association, June 3, 1909.

of the larynx resists for a long time the invasion of the lymphatic system, so that even in far-advanced disease there may be no extension beyond the boundaries of the larynx itself. Theoretically, the tributary lymphatics should be removed in every case; and in any case where there is evidence or suspicion of their involvement their removal is imperative. At the same time, intralaryngeal cancer produces symptoms from the very outset and on examination by a competent laryngologist, the new growth can usually be discovered and a portion of it removed for microscopical examination at a quite early stage of the disease. If by the aid of the microscope the diagnosis cannot be confirmed, operation should be undertaken with a view to an exploratory thyrotomy as a first step. The functional result after complete laryngectomy is usually very satisfactory, and the inconvenience slight, although the patient may, in some cases, have to wear a tracheal tube part of the time or even perhaps constantly.

Attempts to use an artificial larynx have been generally abandoned for many years, so that convalescence is expedited, swallowing is not interfered with and the operation itself is much simplified by the immediate closure of the pharynx.

It has been found that even without any form of phonation apparatus, satisfactory whispering speech can be developed. This was studied some years ago by Dr. J. Solis-Cohen (*Journal of the American Medical Association*, vol. xvi, p. 834) in a patient of his in whom speech was developed to a remarkable degree; and although no attempt was made in any of my cases to provide for an artificial larynx or to use any form of phonation apparatus, a very fair amount of whispering speech was developed after a little time, in all cases, so that the patient had very little inconvenience in communicating with his family and friends. In fact, the result, as far as speech was concerned, was not much inferior to that which I have observed in cases after the intralaryngeal removal of a new growth.

Since February, 1898, I have removed the larynx in 12 cases for carcinoma. Seven of these operations were for intrinsic laryngeal cancer, all far advanced; and in one of these,

the disease had extended to the pharynx. In 5, the primary disease was in the pharynx and had invaded the larynx secondarily. Of the 12 cases operated upon, 7 recovered; one of the 7, however, died on the fifty-eighth day from recurrence, or rather from extension, along the carotid glands into the mediastinum. Of the 5 deaths, 2 were from pneumonia—seven and fifteen days after operation respectively—and 2 from cardiac causes—four and five days respectively after operation. In one unfortunate case in which the patient was suffering from complete obstruction in the œsophagus, I was unable to get below the disease, and all that I could do was to fix a tube into the œsophagus after operation. Death occurred within three days. This woman had come from the Pacific coast for operation. She had not been able to swallow solids for a month, and at the time of operation she had not been able to swallow anything for seven days. I recommended gastrostomy, but she insisted upon radical operation, and I yielded, contrary to my judgment. It was impossible even at the operation to determine the lower limit of the disease in the œsophagus.

Of the 7 cases of intrinsic laryngeal cancer, 4 recovered and 3 died; and of the 5 cases in which the disease was primary in the pharynx, 3 recovered and 2 died.

In the first 4 cases, I did a preliminary tracheotomy and removed the larynx from above downwards. One of these cases died of pneumonia. In the last 8 cases, no preliminary tracheotomy was done, and the mass was removed from below upwards after fixation of the tracheal stump to the skin. This is undoubtedly a much better method of extirpating the larynx than by operating after preliminary tracheotomy. In all cases, operation was done with the patient in an exaggerated Trendelenburg position, and the patients kept in this position with the foot of the bed elevated for some days after operation. The intention was to allow of the secretions gravitating upwards rather than gravitating downwards into the trachea and invading the lungs. I am of the opinion that this attention to posture is most important. In all cases the pharynx was

closed and no attempt was made to prepare the patient for an artificial larynx.

Chloroform was the anæsthetic employed and no difficulty was experienced with the breathing even during the manipulations which were necessary to free the larynx from the neighboring tissues. The operative procedure was briefly as follows. With the patient in the Trendelenburg position and the neck extended, a median incision was made from the hyoid bone to a point a little below the cricoid cartilage. From the upper extremity of this incision on each side, a transverse incision was made to—or nearly to—the border of the sternomastoid muscle. The larynx was then separated from the surrounding structures. In cases of purely intralaryngeal growth, the box of the larynx was separated from its attached muscles by blunt dissection. In the cases in which infected glands or other structures were to be removed, the line of cleavage was made by dissection at a more remote point. In any case, after the mass to be removed—the larynx and whatever structures were to be removed with it—had been entirely isolated, the isthmus of the thyroid was divided between ligatures and the trachea freed for some distance below the cricoid. (The most difficult dissection of all is the separation of the cricoid cartilage and upper rings of the trachea from the upper part of the œsophagus.) Two strong silk sutures were then inserted into the trachea, usually between the second and third rings, and brought out so as to include the ring above. The trachea was then severed between the cricoid and the first ring or between the first and second rings, and the stump withdrawn through a transverse incision made through the skin and fascia a little below the lower end of the vertical incision; and sutured to the skin with silkworm gut sutures.

It is important, I believe, to bring the stump of the trachea well forward, so that at least one ring shall project beyond the skin. Subsequent retraction of the tissues will bring this down to the level of the neck.

It is also, I think, important to bring it out through a transverse incision to prevent the cartilaginous rings from

closing in upon the posterior membranous portion of the trachea, thus narrowing its lumen.

The larynx was then dissected from below upwards and removed. In all my cases the epiglottis was included in the mass removed. The pharynx was then, where possible, completely closed with the exception of a small opening on one or both sides at the outer extremity of the transverse incision, into which a drainage tube was inserted to allow of the draining away of the mouth and pharyngeal secretions and to prevent their accumulation in the pharynx. It was hoped in this way to avoid efforts at swallowing.

In some of the cases, which I shall mention specially, portions of the œsophagus and considerable areas of the pharyngeal structures were removed and complete restoration of the pharyngo-œsophageal canal was impossible.

In the cases in which the pharynx was completely closed, the question of feeding the patient had next to be considered. In my earlier cases, I introduced an œsophageal tube from the outer extremity of the transverse incision on one side and fed in this way for a time. In other cases, I introduced a tube through the nostril into the œsophagus; and in still others, I passed a tube into the œsophagus through the mouth, attaching a silk thread to it and allowing it to lie within the buccal cavity.

All these methods of feeding are more or less objectionable and, in my opinion, this is the most difficult question to deal with in connection with the operation.

In one case—Case III—I made no such provision for feeding—fed by rectum for twenty-four hours; then introduced a stomach tube twice during the next day; and on the third day allowed the patient to swallow; which he was quite capable of doing. The result was infection of the wound, considerable sloughing of tissue and a very much prolonged convalescence. This, I believe, to be a real source of danger in allowing the patient to swallow too early. I now feel disposed to go back to the method of inserting a large sized catheter into the œsophagus from the extremity of the transverse portion of the incision in the neck.

In all cases which survived, a satisfactory amount of whispering speech was developed.

Case I lived for either four or five years and died from recurrence in the lungs, as shown by autopsy. From his own account, he developed speech to a very satisfactory degree.

Case II lived four and a half years and died of an acute abdominal condition of seven days standing; either peritonitis or intestinal obstruction. He acquired a useful amount of speech.

Case III lived seven years and eight or nine months and died of recurrence at the base of the skull. He developed an amount of speech which enabled him to carry on an extensive business quite satisfactorily.

Case IX, who was operated upon in March, 1908, and last seen in January, 1909, was then in perfect health, but had not, up to that date, developed speech to any very great extent.

Cases X and XI are recent operations and did not develop a great degree of speech. Case XI died of pharyngeal recurrence six months after operation.

It is sometimes necessary before proceeding to complete laryngectomy to do a thyrotomy in order to demonstrate the condition within the larynx.

In all the cases which I have had to deal with, the diagnosis was unmistakable both as regards the nature of the disease and its extent; at all events it was quite clear that it was sufficiently extensive to justify a complete laryngectomy, and I cannot help thinking that complete laryngectomy is a safer operation, in most cases, and gives practically as good a result as hemilaryngectomy or intralaryngeal removal after thyrotomy, except when the disease is very limited and seen very early, and also that an exploratory thyrotomy should in most cases be unnecessary and must to some extent complicate the operation.

After-treatment, in addition to the question of feeding, is important. Some surgeons recommend that the patient should be allowed to sit up within a day or two after operation. The reasons given for this advice are, of course, convincing, but at the same time I believe that the necessity of guarding against

the entrance of wound secretions into the trachea is more important than any other single consideration. Moist gauze placed over the tracheal orifice and a warm room with equable temperature and moist air and change of position from side to side, are the most important indications.

In two of my cases (V and XII) where death occurred with cardiac symptoms, I am of the opinion that perhaps more systematic attention to feeding and stimulation might have tided them over.

The high mortality rate in this series was due, at least to some extent, I believe, to the fact that operation was decided upon in every case entirely from the local conditions, and in several of the cases the general condition of the patient while not so bad as to preclude operation was far from satisfactory. It will be noted that in every one of the fatal cases, there was some serious complicating condition.

CASE V was a feeble old man of 74 years, with very advanced disease.

CASE XII, æt. 56, was a patient who had deferred operation until breathing had become almost impossible. Autopsy showed fatty infiltration and degeneration of the heart and acute myocarditis.

Of the two cases which died of pneumonia, Case IV was a man aged 60 who had been compelled to depend entirely upon the catheter to evacuate his bladder for five years prior to operation, on account of prostatic disease.

CASE VIII, a woman aged 50, had a large cancerous growth in the pharynx and upper portion of the œsophagus which had extended to the larynx. She had suffered great pain and difficulty in both swallowing and breathing for some time before operation and was in an exhausted condition.

CASE VII has already been referred to as having presented herself with an extensive cancer of the œsophagus which had prevented her from swallowing even liquids for seven days prior to operation. She was in an almost moribund condition and should not have been operated upon at all.

CASES X and XI present some points of special interest. In Case X I removed a considerable area of the pharynx with the

retropharyngeal tissues and lymphatic glands. I then attempted to unite the upper and lower pharyngeal borders at some points, with the hope of securing some continuity of mucous membrane which would protect against contraction and might even perhaps cause some epithelial growth to extend over upon the cicatricial tissue. The tension was too great and the result was a failure. Contraction of this portion of the pharynx occurred, for which the patient is obliged to wear a tube to keep the passage open sufficiently to enable her to take food. She takes out the tube at meal times and swallows naturally, but wears it in the intervals. This is, of course, a serious inconvenience.

In Case XI I was barely able to bring the stump of the œsophagus out and attach it to the skin below and to the side of the tracheal stump. The removal of pharyngeal tissue was so extensive that there was no possibility of establishing a communication with a continuity of mucous membrane between the mouth and the œsophagus. This patient fed herself with a tube and got along very well, but has since died from local recurrence.

In conclusion, I desire to express my opinion that complete laryngectomy is an operation which should have almost no essential mortality,—and when diagnosis is made early, which can be so readily done, there should be no recurrence of the disease. Moreover, the patient's comfort should be greater than after most operations which involve the ablation of an important organ.

I have not had the experience to justify me in comparing total laryngectomy with hemilaryngectomy or thyrotomy for the removal of intralaryngeal cancer, which latter operation has been so highly recommended by English authorities—notably, Mr. Butlin and Sir Felix Semon—but, as a general surgeon, the principle of wide extirpation of the local disease appeals to me very strongly, and the condition of the patient after operation is a much more tolerable one than it is generally thought to be.

THE OPERATIVE TREATMENT OF HEART WOUNDS.

REPORT OF A CASE OF WOUND OF THE RIGHT AURICLE; SUTURE; RECOVERY. TABULATION OF 158 CASES OF SUTURED HEART WOUNDS.

BY CHARLES H. PECK, M.D.,

OF NEW YORK CITY,

Attending Surgeon, French Hospital; Junior Attending Surgeon, Roosevelt Hospital; Adjunct Professor of Clinical Surgery in Columbia University.

On the evening of June 14, 1908, at about eleven o'clock, a colored girl, 24 years of age, was brought to the Roosevelt Hospital in the ambulance, having been stabbed in the chest with a pocket-knife about 20 to 30 minutes before her arrival at the hospital. I happened to reach the hospital at almost the same moment on a call to another case, and saw the patient in less than five minutes after her admission. The ambulance surgeon and house surgeon had already concurred in a diagnosis of wound of the heart. There was no radial pulse, but a weak pulse varying in force and volume with each inspiration and expiration could be felt high in the brachial artery, and in the carotids. The heart sounds could not be heard. Respiration was faint and shallow, extremities cool, and the patient in profound shock. The area of cardiac dulness was increased but no attempt was made to accurately map it out. The left pulmonary signs were normal. The patient was intoxicated, restless and irritable when aroused, otherwise apathetic. There was a stab wound at the left border of the sternum over the third costal cartilage, which bled very little, and two superficial stab wounds on the right and left breasts respectively, as well as several scars on face, chest and arms, the result of previous battles (see Fig. 1).

The patient was taken at once to the operating room and chloroform and ether anæsthesia commenced, at 11.15 P.M., about 45 minutes after the receipt of the injury. A quadrangular flap with base external, its margins at the second interspace, left half of sternum, and fifth interspace, was rapidly marked out and the soft parts dissected back. A portion of the sixth costal carti-

* Read before the American Surgical Association, June 4, 1909.

lage was excised, the fourth and fifth cut at their sternal attachments, and the third found to have been severed by the stab wound. The internal mammary vessels were ligated above and below, the third, fourth and fifth ribs partly cut through with bone forceps near the costochondral junction to form a hinge and the musculocartilaginous flap carefully lifted, the pleura being pushed away from its deep surface with gauze pads. Except for an accidental tear near the lower portion of the flap, which was covered at once with gauze pads, no opening in the pleura was made. The stab wound in the pericardium, about 1.5 cm. long was so close to the edge of the sternum, that for a good exposure, removal of a portion of the bone with rongeur forceps was necessary. The pericardial wound was apparently closed by clot or the valve-like effect of the intrapericardial tension, and did not bleed, but there was a considerable amount of clot infiltrating the areolar tissue of the anterior mediastinum. Intrapericardial tension was so great that the heart beat could not be felt even with the finger directly on the sac. The pericardium was opened with a 3-inch longitudinal incision, 1 inch to the left of the stab wound, and about 300 c.c. of dark blood escaped with a gush, the anæsthetist noting immediate return of the radial pulse. The degree of "heart tamponade" had been extreme, and had evidently nearly reached the fatal limit of complete arrest of venous return to the auricles.

The bleeding seemed to come from the upper right portion of the pericardial sac, but the rapidly beating heart, churning the free blood, made it impossible to locate the wound until a transverse cut in the pericardium to the right gave a better exposure. Then by lifting the heart forward with the left hand and rotating it slightly to the left, a wound of the right auricle about 1 cm. long and 2 cm. above the auriculoventricular groove, was brought into view. With each systole a stream of dark blood spouted two or three inches. A suture of No. 0 chromicized catgut was passed on a curved intestinal needle and tied, the ends left long, helped to steady the heart while three more similar sutures were inserted—four in all—completely controlling the bleeding. An effort was made to avoid piercing the endocardium, but whether successful or not, in the thin auricular wall, is doubtful. The rapid, tumbling action of the heart made it impossible for me to tell whether the sutures were passed and

tied in systole or diastole. The pericardium was emptied of blood and clot with the hand and gauze sponges, and closed without drainage with continuous sutures of No. 2 chromicized catgut. The musculocartilaginous flap was carefully sutured with No. 3 chromicized catgut, the flap of soft parts, after excising the stab wound, with catgut, silkworm-gut and a continuous silk suture. The suture of the flaps completely closed the accidental tear in the pleura and stopped the sucking in of air. No drainage was used. An intravenous saline infusion of 1200 c.c. was given on the table during the progress of the operation, which lasted 65 minutes. On return to the ward from the operating room, her pulse was 136; respiration, 56; temperature, 99.6. Six hours later another infusion of 900 c.c. was given, as the pulse had become very weak.

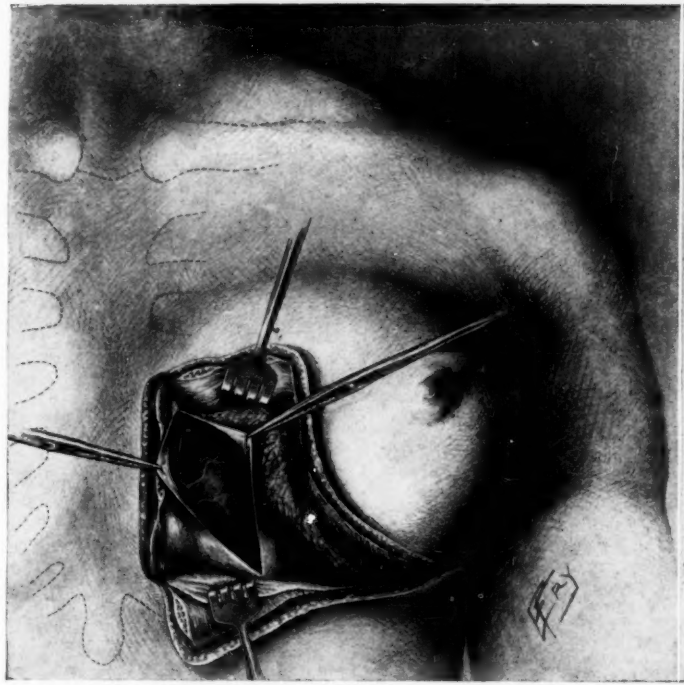
For the first six or seven days there were signs of a mild pleurisy (dulness and diminished voice and breathing) in the left chest; temperature ranged from 100 to 102.8; pulse, 116 to 136; respiration, 24 to 36. At the end of the second week the signs had nearly disappeared, and pulse and temperature were approaching the normal. The wound healed by first intention; all sutures were removed on the eighth day; she was allowed out of bed on the seventeenth day and left the hospital well on July 8, 24 days after the operation. Her pulse at that time was 80–96, regular and of good quality. The heart sounds were normal and the signs of pleurisy had disappeared.

Nearly all writers on heart wounds of both clinical and experimental work, have considered wounds of the auricles more dangerous than those of the ventricles, but of the 11 reported cases of auricle wounds operated upon, 7 have recovered and 4 have died—a mortality of 36.3 per cent., while the general mortality of sutured heart wounds is about 64 per cent. Of the 160 tabulated cases there were 69 of the right ventricle with 48 deaths (69.6 per cent.); 74 of the left ventricle with 45 deaths (60.8 per cent.); 5 of the left auricle with 2 deaths (40 per cent.); 6 of the right auricle with 2 deaths (33.3 per cent.); and 7 miscellaneous cases with 5 deaths (71.5 per cent.); a total of 102 deaths and 58 recoveries (63.7 per cent.).

FIG. 1.

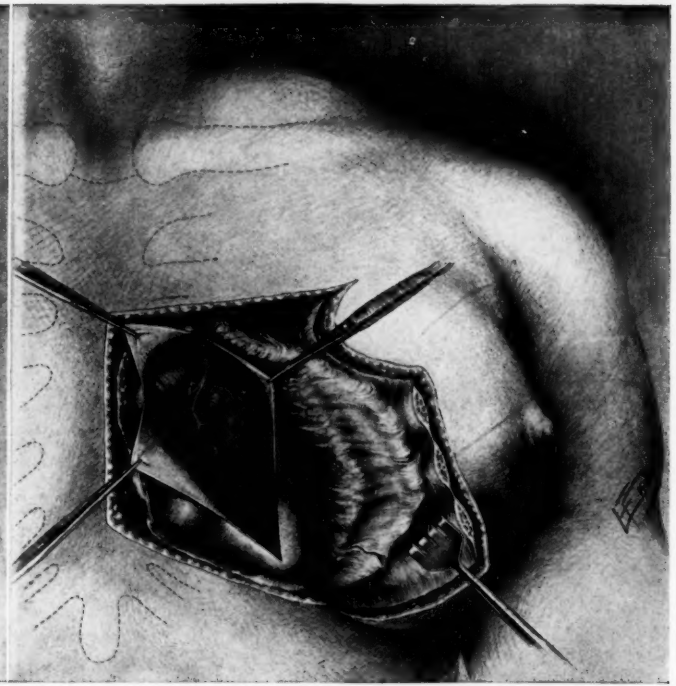
Photograph taken three weeks after operation, showing healed incision and scars of other stab wounds. (Author's case.)

FIG. 3.



Long intercostal incision in fifth space, with division of fourth, fifth, and sixth cartilages at their sternal attachments, forming two triangular flaps. Pleura freely opened.

FIG. 2.



Quadrangular flap of third, fourth, and fifth ribs, hinge external. The drawing represents in addition the removal of part of the sternum, additional transverse incision in pericardium, accidental tear in pleura, and wound of auricle—author's case. With care in elevating the flap, the pleura may be pushed back without injury.

Except as regard the auricle wounds these statistics do not vary greatly from those that have been published from time to time during the past nine or ten years, by Giordano, Hill, Rehn, Lenormant, Stewart, Vaughan, and others. In only a comparatively small precentage of all inflicted heart wounds will surgical intervention be possible. In the larger wounds fatal hemorrhage into the pleural cavity or through the external wound usually takes place. In smaller wounds the pericardial opening may be closed by clot or valve-like pressure, producing the so-called "heart tamponade," the intrapericardial pressure preventing the entrance of blood through the great veins in to the auricles, and consequent pumping dry of the ventricles. In this condition it is the mechanical choking or drowning of the heart, and not the loss of blood which determines the fatal issue. Spangaro's [96] conclusions from recent experimental work are that "the consequence of hæmopericardium is to render diastole difficult and aspiration insufficient, whence an important and progressive lessening of blood pressure and weakening of the pulse. For this the hæmopericardium need not be abundant. After removal of blood from the pericardium the pressure augments and the pulse becomes more or less normal."

This has been strikingly shown in many of the cases operated upon, my own included, and has led to the suggestion that preliminary aspiration of the pericardium be made as soon as the case is seen, to give temporary relief while preparation for the operation is being made. Few if any deaths are directly due to the shock of the heart injury. Kronecker and Schmey [51a] claim that there is a point at the junction of the upper and middle thirds of the interventricular groove, where in animals simple puncture is capable of causing immediate and permanent stoppage of the heart's action, and have called this the "co-ordination centre."

Elsberg,[23] in an elaborate series of experiments on animals made in 1899 at Breslau, showed conclusively that the heart in dogs and rabbits is capable of resisting trauma to an astonishing extent, even ligation of the entire heart at the junction

of the lower and middle thirds of the ventricles and amputation through the ventricles below the ligature being followed by recovery of the animal.

Traver's[105] case corroborates the view that the human heart has similar powers of resistance. A boy 19 years of age was impaled on an iron picket fence. The sternum was fractured and the right ventricle wounded, the heart wound being plugged by a fragment of bone. Terrific bleeding through the extensive tear in the heart wall followed removal of the fragment of bone, the hemorrhage being temporarily checked by three fingers passed through the wound into the cavity of the ventricle. Twenty-three stitches (in two tiers) were used in closing the 2¼-inch wound in the ventricular wall, and the patient lived more than ten days, death occurring from slow secondary hemorrhage into the pericardium due to imperfect healing of the contused and lacerated wound edges, and not from sepsis. This was probably the most extensive heart wound ever sutured with even temporary success.

Certain and rapid healing of sutured heart wounds may be definitely counted upon if death from hemorrhage or shock is averted, and septic infection prevented. Elsberg has shown that repair takes place as in other muscles, by the formation of fibrous cicatricial tissue and not by regeneration of heart muscle, but that it is none the less strong, and the function of the heart muscle is not seriously impaired.

The suggestion that wounds of the human heart might be sutured was made by Dr. Roberts of this Association in 1881 and was received with skepticism. Farina[24] of Rome, in 1896, is credited with the first operation, and Rehn[82] of Frankfort in 1897 with the first recovery. In this country Nietert[70] and Vaughan[108] led the way in 1901, and up to the present time 16 cases have been operated upon with 7 recoveries. The 160 tabulated cases have been reported by 121 different operators, no surgeon having reported more than three cases. The rarity of the opportunity and the importance of prompt and definite action make it desirable that every

surgeon to whom such a case may come should be familiar with the best plans of operative procedure, in order that the choice of method may be instantaneous and the steps executed without delay. These steps involve the consideration of:

1. Anæsthesia.
2. Local preparation of the operative field.
3. Choice of method of exposure.
4. Temporary control of hemorrhage while sutures are being placed, and sutures.
5. Stimulation and resuscitation.

Anæsthesia.—Of this little will be said; the need of a general anæsthetic and the method of administration is decided by the operator on general principles, as in other desperate conditions.

Local Preparation of the Operative Field.—As infections have occurred in more than 50 per cent. of all patients who have recovered, and at least 40 to 50 per cent. of the fatal cases, this is a matter of vital importance. It should be done rapidly but thoroughly, while the patient is being anæsthetized, the usual cleansing with soap and water, alcohol, etc., being followed by the application of tincture iodine or Harrington's solution to the entire operative field. The operator should be ready by the time the patient is prepared and anæsthetized, and the whole proceeding should take very few minutes. Excision of the original stab or bullet wound in the soft parts is also important, as some of the infections have undoubtedly originated here.

Choice of Method of Exposure.—The fact that the 158 reported cases have been distributed among 119 different operators helps to explain the diversity of opinion as to the best method of approach, and the many methods which have been employed.

The quadrangular flap with hinge external, including from two to five cartilages has much to commend it (Fig. 2). It has been the favorite method of the French since Fontan's case in 1900. It gives a good exposure, can be rapidly formed with few vessels to control and makes it possible to avoid injury

to the pleura, an important point if hæmopneumothorax is not already present.

A quadrangular flap with hinge internal at the sternal border has been used many times, but gives a less free exposure of the right ventricle and auricle and widely opens the pleura. In a few cases this latter type of flap has included transverse divisions of the sternum at its base, the hinge being made at the junction of the right costal cartilages with the sternum. This procedure endangers the right pleura, injury to which would mean double pneumothorax and death (see Case 127).

A long intercostal incision, usually in the fifth or fourth spaces, to which may be added division of one or more cartilages at their sternal attachments, forming one or two triangular flaps (Fig. 3), is another method advocated of late on account of its simplicity and rapidity of execution. It involves free opening of the pleura, but in many of the cases the pleura has already been wounded and hæmopneumothorax is present. In some cases—tall individuals with wide intercostal spaces—the intercostal incision with strong retraction gives sufficient exposure without cutting rib or cartilage.

The dangers of pleural opening will be greatly diminished if the principle of performing thoracic operations under negative or positive pressure, which is now attracting so much attention in the surgical world, becomes practical and more generally available.

Temporary Control of Hemorrhage While Sutures are Being Placed; Sutures.—After the pericardium is freely opened by enlarging the original wound or by a longitudinal incision, fresh bleeding increased by the relief of intrapericardial tension, may be a serious danger. The heart wound may be large enough to be plugged temporarily by a finger, or rarely more than one, as in Travers' case. Haecker [42a] has recently shown on dogs that compression of the base of the heart between two fingers, completely shutting off return of blood to the auricles, is borne without ill effect about 1½ minutes continuously, and up to 10 minutes with short intermissions. Generally, it has been sufficient to quickly place one or

two sutures to co-apt the edges of the wound enough to partly check the hemorrhage, adding others to complete the control if necessary, more deliberately.

The end of the first suture left long is a great aid in steadying the heart for the placing of others. A separate temporary stitch through the muscle at the apex for this purpose, as advocated by Spangaro, should be unnecessary. Sutures of fine catgut, chromicized catgut, or silk have proven equally efficacious and harmless. A small curved intestinal needle should be used, and the endocardium should not be included in the stitch. Interrupted, continuous or mattress sutures may be used. A slight irregularity of the heart's action may be caused by the first manipulation with the hand or needle puncture, but it is the experience of most observers that this effect it quite transitory and the heart soon recovers its equilibrium.

Stimulation and Resuscitation.—The most effective stimulation is intravenous saline infusion given while the operation is in progress, which has been successfully used in many of the reported cases. Direct heart massage, for cessation of the heart beat, has been employed several times, with apparently benefit in some instances. It should be given a thorough trial before abandoning a case as hopeless, combined, perhaps, with direct infusion into the ventricles.

Wound Closure and Drainage.—A study of the Table shows, excluding 35 cases which died on the table or very soon of hemorrhage or shock, and 13 of unknown causes, that in the remaining 112 it is definitely stated that 67 (60 per cent.) had infections of pericardium or pleura or both, 41 of whom died and 26 recovered. Unquestionably the use of drainage has in some instances favored the development of secondary infections of pleura or pericardium, and I believe that closure of both without drainage, in conjunction with systematic careful preparation on the lines suggested, is, as a rule, the best procedure. If the pleura has contained much blood and has been widely opened, drainage of the pleura alone may be indicated and should preferably be made pos-

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
1	BARTH..... 1901	Stab wound through ensiform cartilage	Right pleura and tricuspid valve wounded	½ hour	Right vent. 2 cm.
2	BARTH..... 1902	Stab wound 3 cm. within and below left nipple	.....	1 hour	Right vent. 0.75 cm.
3	BAUDET..... 1906	Stab wound in 5th left space, 2.5 cm. within and 1 cm. below left nipple. Male; 23 yrs.	.....	1 hour	Right vent., near interventricular groove, very small
4	BAYHA..... 1908	Stab wound below 5th rib, 2 fingers' breadth from sternum. Male; 24 yrs.	Left pleura filled with blood	2–3 hours	Right vent., middle, transverse. 1 cm.
5	BLAKE..... 1907	Stab wound through 4th left cartilage, 1 cm. within nipple line. Male; colored	Left pleura contained 2 pints of blood; pericardium about 2 oz.	2½ hours	Right vent. 1 cm.
6	BORZYMOWSKI 1903	Two stab wounds over 4th left cartilage	.....	.....	Right vent
7	BOUGLE..... 1901	Pistol-shot wound in 3rd left space, one finger's breadth from sternum	.....	½ hour	Right vent. 2 wounds
8	BRENNER..... 1900 (report by Zulehner)	Stab wound at border of sternum, level of 6th cartilage. Male; 35 yrs.	Penetrating abdominal wound	More than 24 hours	Right vent. 2 cm.
9	BUFNOIR..... 1899	Pistol-shot wound, 22 caliber, in 5th left space	.....	.....	Right vent.
10	CAMUS..... 1905	Stab wound in 4th left space, 1 finger's breadth from sternum, 2cm. in length. Male; 43 yrs.	Left hæmothorax, large amount	1 hour	Right vent. 1 cm.
11	CAMUS..... 1905	Stab wound in 3rd left space, midway between nipple and sternum. Male; 18 yrs.	Left hæmothorax, large amount. Wound extended into root of pulmonary artery	1 hour	Right vent. 1.5 cm.
12	CAPELLO..... Cimorini 1904	Stab wound through 7th left cartilage, at margin of sternum	Peritoneum wounded	.....	Right vent.
13	CARNABEL..... 1900	Stab wound in 3rd left space, 3 cm. from sternum	.....	2 hours	Right vent. 2 cm.

RIGHT VENTRICLE

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
Resection of 5th, 6th and 7th costal cartilages. Chloroform. 4 silk sutures	Drainage	Drainage	Pleuritis	Died on 4th day.
Resection of 5th rib and 6th cartilage. No anæsthetic. 3 sutures	No drainage	No drainage	Pleuritis	Recovered.
Quadrangular flap, hinge external. Pleura freely opened. Chloroform. Wound sutured	No drainage	No drainage	Pleuritis; not drained	Recovered. Patient ran 100 feet after receipt of injury.
Resection of 5th rib and 6th cartilage. Pleura freely opened. Ether and chloroform. 3 sutures, deeply placed	No drainage	Drainage in posterior axillary line; resect 9th rib	Empyema; secondary drainage 14 days after operation	Recovered. Examined 7 months later; heart sounds normal; action regular.
Flap of 3rd, 4th and 5th cartilages, hinge internal. Pleura freely opened. Ether. 3 interrupted silk sutures; 1 mattress suture over them	No drainage	No drainage. Gauze drain in stab wound	Double pneumonia; left empyema, drained on 26th day after operation. Wound infection	Recovered.
Flap of 3rd, 4th and 5th ribs, hinge external. Ether. One wound sutured	.....	.....	Pericarditis and pleuritis	Died two days later. Two wounds found; only one sutured.
Flap of 3rd, 4th and 5th ribs, hinge external. Chloroform. Both wounds sutured with catgut	No drainage	Drainage	.....	Died 5 hours later. Ball had passed through wall of ventricle, not opening cavity.
Resection of 5th, 6th and 7th ribs. Chloroform. Sutures tore out at first. Suture not completed	.....	.....	.....	Died on table. Heart muscle degenerated and friable.
Wound of entrance sutured; wound of exit not sutured	.....	.....	.....	Died.
Flap of ½ width of sternum, 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Anæsthesia. Wound sutured with catgut	Small drain	Gauze drainage	Left pneumonia	Died 22 hours later.
Flap of 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Anæsthesia. Wound sutured with No. 0 catgut	.....	.....	.....	Died on tabl
Resection of 4th, 5th, 6th and 7th cartilages. No anæsthetic. 8 sutures	Drainage	.....	Suppurative pericarditis; heart sutures discharged in pus on 15th day. Subphrenic abscess	Died 2 months later.
Resection of 4th and 5th cartilages. Ether. 3 catgut sutures	Drainage	Drainage	Pericarditis and pleuritis	Died 4 days later.

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
14	CHASTENET DE GERY..... 1908	Horizontal stab wound 5 cm. long in 3rd left space. 1½ cm. from sternum. Male; 24 yrs.	Left pleura full of blood; interventric; septum wounded	3 hours	Right vent. Near intervent. groove. 1 cm.
15	DOLCETTI..... 1906	Stab wound in 5th left space within nipple line	.....	1 hour	Right vent. 1.5 cm.
16	FARINA..... 1896	Stab wound at upper border of 6th left rib near sternum	.....	.....	Right vent. 6 mm.
17	GAUDEMET..... 1905	Stab wound in 5th left space, 5 cm. from median line	Hæmopericardium, 200 c.c.	1½ hours	Right vent, near auricle, 4 mm.
18	GENTIL..... 1904	.....	.....	.....	Right vent.
19	GERZEN..... 1902	Stab wound below left costal arch	.....	.....	Right vent. 2.5 cm.
20	GIBBON..... 1902	Stab wound through 4th costal cartilage. Male; colored; 25 yrs.	No wound of pleura	1 hour	Right vent. 1.5 cm.
21	GIBBON..... 1905	Stab wound through 4th costal cartilage	Pleura not wounded	2 hours	Right vent. near auriculovent. groove, ¾ in.
22	GIUDICE..... 1905	Stab wound in 3rd left space	.....	Soon	Right vent. 1 cm.
23	GRASSMAN..... 1908	Stab wound in 4th space, 1 cm. from border of sternum. Male; 14 yrs.	Left hæmothorax, 1½ liters. Hæmopericardium, large amount	3¾ hours	Right vent. 1½ cm.
24	GRASSMAN..... 1908	Stab wound in 4th space, 2 cm. from sternum. Male; 30 yrs.	Left hæmothorax, 1½ liters, very little hæmopericardium	½–1 hour	Right vent. transverse 3 cm.
25	GREKOW AND ZEIDLER..... 1903	Stab wound outside left nipple	.....	5 hours	Right vent. near apex. 1.5 cm.
26	GREKOW AND ZEIDLER..... 1903	Stab wound in 2nd left space	.....	4½ hours	Right vent. 1½ cm.
27	GUENOT..... 1905	Stab wound in 2nd right space, 2 cm. from sternum. Male; 32 yrs.	Right hæmopneumothorax; 1½ litres of blood	1 hour	Right vent. 1 cm.

RIGHT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Results and remarks.
	Pericardium	Pleura		
Flap of 3rd and 4th ribs, hinge external. No anæsthetic. Several catgut sutures	.....	.....	.....	Died on table; heart massage continued for 35 to 40 minutes without effect.
Resection of 4th and 5th cartilages. Eucain analgesia. 3 silk sutures	No drainage	Drainage	Peritonitis and mediastinitis	Died 7 days later; Heart stopped during operation and was revived by massage.
Resection of 5th, 6th and 7th cartilages. Chloroform. 3 silk sutures	No drainage	.....	Bronchopneumonia	Died 5 days later of pneumonia. Heart wound found healed at autopsy.
Flap of 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Chloroform. 3 catgut sutures	Drainage	Posterior drainage in 8th space	.....	Died 24 hours later. Clot found in tricuspid valve, probably the cause of death.
Flap of ribs, hinge external	.....	.....	Pericarditis. Syphilis	Died 17 hours later.
Resection of 5th, 6th, 7th, 8th and 9th cartilages. Pleura not opened. Chloroform. 4 sutures	Drainage	.....	Pericarditis and pleuritis	Died 23 days later.
Skin flap; excision of 3rd and 4th cartilages. Chloroform. 1 catgut suture	.....	.....	.....	Died on table.
Resection of 4th rib and cartilage. Ether. 4 chromic catgut sutures	Gauze drain	No drainage	.....	Recovered.
Resection of 4th and 5th cartilages. Catgut sutures	Drainage	Drainage	.....	Died next day from effects of hemorrhage.
Resection of 4th and 5th cartilages. Pleura freely opened. Chloroform. 5 silk sutures	No drainage	No drainage	Nonsuppurative pericarditis and pleuritis. Superficial abscess in wound	Recovered.
Resection of 4th and 5th cartilages. Pleura freely opened. No anæsthetic. 4 silk sutures	.....	.....	.....	Died on table. Heart massage and direct infusion into ventricle without result
Resection of 3rd, 4th and 5th ribs. Chloroform. 2 silk sutures	No drainage	Drainage	Pericarditis and pleuritis	Died 60 hours later.
Resection of 3rd, 4th, 5th and 6th ribs. Chloroform. 5 silk sutures	No drainage	No drainage	Pericarditis and pleuritis	Died 13 days later.
Flap of 3rd, 4th, 5th and 6th right ribs, hinge external on right. Right pleura freely opened. Chloroform. 3 catgut sutures	No drainage	No drainage	Hemorrhage of 700 Gm. from a parietal vessel, into right pleura, after operation	Died 28 hours later. Infusion of 5 liters saline solution given during operation.

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
28	HESSE..... 1905	Scissors wounds in 4th and 5th left spaces. Male; 25 yrs.	Left hæmothorax, large amount	¾ hour	Right vent. near apex. 1 cm.
29	HORODYNSKI..... 1899	Stab wound in 3rd left space, 2 cm. from sternum. Female; 23 yrs.	Pleura and lung wounded, left hæmo-pneumothorax	1 hour	Right vent. lower third
30	ISNARDI AND COLOMBINO..... 1902	Stab wound in sternum at articulation of 5th left costal cartilage	.....	2 hours	Right vent. 1.5 cm.
31	KOSINSKI..... 1899	Stab wound in 3rd left space	.....	.....	Right vent.
32	LASTARIA..... 1901	Stab wound in 5th left space, at border of sternum	.....	½ hour	Right vent.
33	LEMAITRE..... 1904	Poniard stab wound in 5th left space, near sternum. Male; 20 yrs.	Injury of diaphragm and left lobe of liver	1 hour	Right vent.
34	LENORMANT..... 1905	Pistol-shot wound in 5th left space, at border of sternum. Male; 16 yrs.	Liver, stomach and intestine wounded	7 hours	Right vent. 15 to 20 mm.
35	LISANTE..... 1899	Stab wound in 4th space, 1 cm. within nipple line	.....	Very soon	Right vent.
36	LISCIA..... 1901	Stab wound in 4th left space	.....	.....	Right vent.
37	MANTEUFFEL..... 1903	Pistol-shot wound, 5. mm. in 4th left space	.....	9 hours	Right vent. 5 mm.
38	MARION..... 1898	Pistol-shot wound in 4th left space, 3 cm. from sternum. Male; 55 yrs.	Pericardium distended with blood	2 hours	Right vent. perforated
39	MIGNON ET SIEUR 1901	Stab wound in 4th left space, 2 fingers' breadth from nipple	Large amount of blood in pericardium	1 hour	Right vent. 1 cm.
40	MILESI..... 1902	Stab wound in 5th left space.	.....	2 hours	Right vent. 1.5 cm.
41	MILESI..... 1903	Stab wound in 4th left space near sternum	.....	1 hour	Right vent. 1 cm.

RIGHT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks.
	Pericardium	Pleura		
Flap of 3rd and 4th ribs, hinge internal. Chloroform. 3 silk sutures.	Drainage	Drainage	Pericarditis and pleuritis	Recovered.
Resection of 3rd, 4th and 5th cartilages. Pleura freely opened. No anæsthetic. 3 deep and 2 superficial sutures	Drainage	Drainage	Pericarditis; double empyema	Died 3 weeks later of empyema.
Resection of 5th and 6th ribs, Chloroform. 3 sutures	.....	Drainage	Empyema; subsequent drainage	Recovered.
5 sutures	.....	.....	.....	Recovered.
Flap of 3rd, 4th, 5th and 6th cartilages, hinge internal. Chloroform. Silk sutures	.....	Drainage	.....	Died next day.
Flap of 3rd, 4th and 5th ribs, hinge external. Slight accidental tear in pleura. Chloroform. 3 catgut sutures	No drainage	Drainage	Empyema	Died 10 days later.
Flap of 4th, 5th and 6th ribs, hinge external. Chloroform. 3 silk sutures	Drainage	.....	Syncope on table; heart massage and traction on tongue revived patient	Died 4½ hours later.
Flap of 4th and 5th ribs, hinge above. Chloroform. Silk sutures	No drainage	.....	Signs of cardiac aneurism at end of 2 months	Recovered.
Flap of 2nd, 3rd, 4th and 5th ribs. No anæsthetic. 3 sutures	.....	.....	Pleuritis; nephritis	Died 42 hours later.
Resection of 4th, 5th, 6th and 7th cartilages. Ether. Silk sutures for both wounds	No drainage	Drainage	Pericarditis: pericardium aspirated 2 days after operation	Recovered. Bullet perforated anterior wall and lodged in posterior wall where it could be felt. Incision and extraction of bullet.
Resection of 6th and 7th cartilages and part of sternum. Ether. Wound of entrance sutured	.....	.....	.....	Died on table.
Resection of 4th, 5th and 6th cartilages. Pleura not opened. Silk sutures	Drainage	Drainage	.....	Died 2 hours later. Suicide during course of a grippe pneumonia.
Resection of 6th rib. Chloroform. 4 silk sutures; 1 deep and 3 superficial	Drainage	Drainage	.....	Died 15 hours later; hemorrhage.
Resection of 4th cartilage. Chloroform. 3 silk sutures, 1 deep and 2 superficial	No drainage	Drainage	Pericarditis	Died 7 days later.

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
42	MORESTIN..... 1903	Pistol-shot wound, 8 mm., through sternum opposite 4th costal cartilage. Male; 20 yrs.	.....	21 hours	Right vent., one wound
43	MUSUMECI..... 1905	Stab wounds in 4th and 5th left spaces	Three intestinal wounds	Soon	Right vent.
44	NANU..... 1900	Stab wounds in 3rd left space, 4 cm. from sternum	Pleura wounded	2 hours	Right vent. near apex, 2 cm.
45	NEUMANN..... 1905	Stab wound below left costal arch in parasternal line. Male; 53 yrs.	.....	.....	Right vent. admitted forefinger
46	NICOLAI 1899	Stab wound in 4th left space, parasternal line	.....	1½ hours	Right vent. near apex
47	NIETERT..... 1901	Stab wound in 5th right space, at border of sternum. Male; 22 yrs.	Pleura not wounded	2 hours	Right vent. ½ inch
48	NIMIER..... 1905	Stab wound in 4th left space, 1 cm. from sternum. Male; 26 yrs.	.....	25 min.	Right vent. 1.5 cm.
49	PECORI..... 1903	Stab wound in 5th left space, within nipple line	.....	.....	Right vent.
50	RAMONI..... 1899	Stab wound over 5th left cartilage, 2 cm. from sternum	.....	½ hour	Right vent. 2 wounds
51	REHN..... 1897	Stab wound in 4th left space, 2 cm. from sternum. Male; 22 yrs.	Left hæmothorax, large amount	More than 24 hours	Right vent. 1.5 cm.
52	REHN..... 1906	Stab wound in 4th left space; fell on knife. Male; 30 yrs.	.....	8½ hours	Right vent.
53	RICHE..... 1902	Stab wound in 4th left space, parasternal line. Female; 30 yrs.	.....	2 hours	Right vent. 5 mm.
54	SAVARIAUD..... 1902	Stab wound in 5th left space, 3 cm. from sternum	Border of lung wounded	.....	Right vent. near apex
55	SAVARIAUD..... 1904	Stab wound below and internal to left nipple. Female; 35 yrs.	.....	2½ hours	Right vent.

RIGHT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks.
	Pericardium	Pleura		
Resection through sternum. Chloroform. 4 catgut sutures	Drainage	Drainage	.....	Died 19 hours later of embolism (?). Bullet found in cavity of right ventricle.
Flap; hinge internal. Ether and chloroform. Suture of heart and intestinal wounds	No drainage	.....	.....	Died 18 hours later.
Resection of 2nd, 3rd and 4th cartilages. 3 catgut sutures	No drainage	Drainage	Pericarditis and pleuritis	Died 4 days later.
Resection of 4th, 5th, 6th and 7th cartilages. Sutures tore out at first	Gauze tampon for hemorrhage	.....	.....	Died ½ hours later; hemorrhage.
Resection of 4th and 5th cartilages. Anæsthetic. Wound sutured	.....	.....	.....	Died 12 hours later.
Skin flap, base to left; partial resection of sternum. Pleura not opened. No anæsthetic. 3 silk sutures	.....	.....	Pericarditis	Died 33 hours later from pericarditis.
Flap of 4th, 5th and 6th ribs, hinge external. Pleura not opened. Chloroform. 4 catgut sutures	Drainage	Drainage	.....	Died next day.
Flap of 5th and 6th ribs. Sutured; first sutures tore out	.....	.....	.....	Died on table; hemorrhage.
Flap of 4th and 5th ribs hinge below. Chloroform. 4 sutures in one wound, 2 sutures in the other	.....	Drainage	.....	Recovered.
Resection of 5th cartilage. Chloroform. Silk sutures	Drainage	Drainage	Empyema; secondary drainage	Recovered.
Flap of 4th and 5th ribs, hinge internal. Pleura freely opened. Chloroform and ether. 10 silk sutures	No drainage	No drainage	Pleuritis; 900 c.c. of fluid aspirated from left chest the day after operation	Died 2 days later.
Flap of 3rd and 4th ribs, hinge external. Pleura freely opened. Chloroform. Wound sutured	No drainage	No drainage	No postoperative complications	Recovered.
Flap of 4th and 5th ribs, hinge external; pleura not opened. Chloroform. 3 sutures	.....	.....	Gangrene of border of lung	Died 52 hours later.
Flap of 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Chloroform. 3 catgut sutures	No drainage	No drainage	Pericarditis; pyopneumothorax	Died 14 days later.

TABLE I—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wounds
56	SCHACHOWSKI..... 1903	Stab wound in 6th left space, near nipple line	.....	.....	Right vent. 1.5 cm.
57	SMITH..... 1904	Stab wound in 4th left space, 2 cm. from sternum. Male; colored; 22 yrs.	.....	½ hour	Right vent.
58	SOAVE..... 1907	Stab wound in 5th left space, 4 fingers' breadth from sternum. Male; 19 yrs.	.....	Very soon	Right vent.
59	STEYNER..... 1903	Stab wound at about 5th rib near sternum	.....	.....	Right vent.
60	THIEMANN..... 1906	Needle fixed at border of 4th rib, 31 mm. in tissues. Male; 23 yrs.	Wound of pleura; slight hæmopericardium, 100 c.c.	4 hours	Right vent. 1 cm. and right auricle 1.5 cm.
61	TRAVERS..... 1906	Impaled on iron picket; wound through lower end of sternum. Male; 19 yrs.	Comminuted fracture of sternum	3 hours	Right vent. trifid wound; 2½ inches
62	VAUGHAN..... 1908	Stab wound in 4th left space, near nipple. Male; colored; 32 yrs.	Left lung and pleura wounded hæmothorax, 1 pint	1 hour	Right vent., lower part, ½ inch
63	VOGEL..... 1903	Stab wound in 4th left space, near sternum. Male; 16 yrs.	.....	At once	Right vent. 1.5 to 2 cm.
64	WALCKER..... 1900	Stab wound below left costal arch in parasternal line. Male; 53 yrs.	Wound of diaphragm and peritoneum	.....	Right vent.
65	WATTEN..... 1900	Stab wound in 4th right space, near sternum	.....	6 hours	Right vent. 2 cm.
66	WATTS..... 1908	Stab wound in 2nd left space, near sternum.	.....	½ hour	Right vent. and root of pulmonary artery
67	WEISS..... 1904	Stab wound	.....	8 hours	Right vent.
68	WOLFF..... 1903	Stab wound. Male	.....	Soon after injury	Right vent. 2 cm.
69	DE ZAWADSKI..... 1907	Stab wound	.....	.....	Right vent.

RIGHT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks.
	Pericardium	Pleura		
Resection of 5th and 6th cartilages. 6 sutures	Drainage	.....	.....	Recovered.
Resection of 4th and 5th ribs and part of sternum. Ether. Continuous silk sutures	No drainage	Drainage	Pericarditis	Died 7 days later.
Flap of 4th and 5th ribs, hinge internal. Chloroform. Silk sutures	Drainage	.....	No postoperative complications	Recovered.
Resection of 4th and 5th ribs. Chloroform. 4 sutures	Drainage	Drainage	.....	Recovered.
Resection of 4th and 5th ribs. Chloroform. 1 catgut suture in ventricle, 4 catgut sutures in auricle	Drainage	Drainage	Pericarditis. Left pleuritis and empyema	Recovered.
Flap of 3rd, 4th and 5th cartilages and part of sternum; hinge below. Chloroform. 23 sutures in 3 rows.	Drainage	Drainage	No sepsis; death due to clot in pericardium from slow secondary hemorrhage	Died on 11th day after operation.
Flap of 4th, 5th and 6th cartilages, hinge internal. Pleura freely opened. Ether. 12 silk sutures in 2 rows	No drainage	No drainage	Delirium tremens	Recovered.
Resection of 4th and 5th cartilages. Chloroform. 5 silk sutures	No drainage	Drainage	Pericardium opened and drained on 2nd day; heart sutures finally expelled	Recovered.
Resection of 4th, 5th, 6th and 7th cartilages: Peritoneum opened. Sutured; stitch tore out	Wound packed with gauze	.....	.....	Died ½ hour later.
Flap of 3rd and 4th right cartilages, hinge external, (to the right). Chloroform. 3 sutures	Drainage	Drainage	.....	Recovered.
Resection of 2nd and 3rd ribs. Ether. Sutured.	No drainage	Drainage	.....	Died one month later.
Resection of ribs, laparotomy Sutured	.....	Drainage	Pleuritis	Died 15 days later.
Intercostal incision in 4th space. 3 continuous silk sutures	No drainage	No drainage	Pericarditis and pleuritis, Thoracotomy on 5th day for empyema	Died 14 days later.
Heart wound sutured	.....	.....	Pneumonia	Died 17 hours later of pneumonia

TABLE II—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
70	ALVEZ DE Lima.. 1905	Stab wound over 4th left cartilage	Mitral valves wounded	Soon	Left vent. 14 mm
71	BARTH..... 1901	3 stab wounds in 4th left space, 3 cm. from sternum. Male; 28 yrs.	.....	½ hour	Left vent. 0.5 cm.
72	BARDENHEUER... 1904 (?)	Gunshot wound	Interventricular septum penetrated; hemorrhage profuse	.....	Left vent.
73	BORCHARDT..... 1904	Impaled on picket fence, fell from tree. Male; 12 yrs.	Hæmopneumothorax Abdominal injury suspected	2½ hours	Left vent. on posterior wall 1.5 cm.
74	BORZYMOWSKI... 1903	Stab wound between ensiform and left cartilages. Male; 22 yrs.	.....	.....	Left vent. apex, 2 cm.
75	BRACHINI..... 1901	3 stab wounds in region of heart. Male; 27 yrs.	.....	At once	Left vent. 2 wounds. One 1 cm., penetrating. One 3 mm.
76	BREZARD AND MOREL.....	Pistol-shot wound, 8 mm. in 3rd left space, 2 cm. from sternum. Male; 19 yrs.	Wound of lung. Hæmopericardium, 100 c.c.	Soon	Left vent. 2 wounds. Cavity not opened
77	CAPPELEN..... 1896	Stab wound in 4th left space, midaxillary line	Pericardium distended with blood. Hæmothorax, 1400 c.c. lung compressed. Coronary artery found cut	1 hour	Left vent. 2 cm.
78	CARMELO..... 1904	Stab wound in 4th left space	.....	.....	Left vent.
79	DUVAL..... 1906	Stab wound in 5th left space, 8 to 10 cm. from border of sternum. Male; 40 yrs.	Coronary vessels injured	Not known, found unconscious	Left vent. 1.5 cm.
80	FISCHER..... 1907	Stab wound in 3rd left space; another over 2nd rib. Male; 45 yrs.	.....	1 hour	Left vent.
81	FITTIG..... 1908	Pistol-shot wound in 3rd left space, internal to nipple. Male; 29 yrs.	Border of lung wounded; sutured	2 hours	Left vent. 2 wounds, ant. and post. 3 cm. and 1 cm.

LEFT VENTRICLE

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
Flap of 3rd and 4th ribs, hinge external. Chloroform. 1 catgut suture	No drainage	Drainage	.....	Died one hour later; hemorrhage. Heart stopped twice during operation and was revived by massage.
Flap of 4th and 5th cartilages, and sternum, hinge on the right. Chloroform. 3 silk sutures	No drainage	Drainage	.....	Recovered.
Sutured	.....	.....	Pericarditis; septic pleuritis	Died ten days later.
Incision over 5th rib from sternum to axilla. Exploratory laparotomy. 4 silk sutures	Drainage	Drainage	.....	Recovered.
Wound enlarged, resection of 4th, 5th and 6th ribs. No anæsthetic. 3 deep and 3 superficial sutures	.....	.....	Suppurative pericarditis and pleuritis	Died 2 days later.
Flap of 3rd, 4th and 5th ribs, hinge internal. No anæsthetic. Penetrating wound closed by 2 sutures	.....	.....	.....	Died on table.
Flap of 3rd, 4th and 5th ribs, hinge external. Chloroform. Both wounds sutured with catgut	No drainage	.....	.....	Died on table from hemorrhage. Heart massage tried ineffectually.
Resection of 3rd and 4th cartilages. Ether. Sutured	.....	.....	Pericarditis	Died 3 days later of pericarditis.
Resection of 4th and 5th cartilages. Chloroform. Silk sutures	.....	Drainage	Bronchopneumonia	Died 3 days later.
Flap of 4th, 5th and 6th ribs, hinge external. Pleura freely opened. No anæsthetic. 2 interrupted sutures	.....	.....	.....	Died on table. Direct infusion of warm salt solution into ventricle after heart had stopped, revived it for a short time.
Wound enlarged; excision of 3rd and 4th cartilages. Ether. 3 silk sutures	Drainage	Drainage	Pericarditis	Died 30 hours later.
Intercostal incision in 4th space; resection of 4th and 5th ribs. 6 catgut sutures in anterior wound	Gauge drain	Large drain	.....	Died 24 hours later; anæmia. Wound of exit did not bleed; not sutured.

TABLE II—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
82	FONTAN..... 1900	Six scissors wounds between 3rd and 7th left ribs. Male; soldier	.....	6½ hours	Left vent. 12 mm.
83	FONTAN..... 1901	Stab wound in 4th left space, 0.5 cm. outside nipple. Male; soldier	.....	2 hours	Left vent. 8 mm.
84	de FOURMESTRAUX 1905	Stab wound—finger's breadth outside left nipple. Male; 24 yrs.	Hæmothorax, large amount, hæmopericardium, 300 c.c.	½ hour	Left vent. 5–6 cm. above apex
85	de FOURMESTRAUX 1905	Stab wound in 4th left space. Male; 23 yrs.	.....	10 minutes	Left vent. extending to right vent. 3 cm.
86	FUMMI..... 1898	Stab wound below left nipple	Pericardium distended with blood. Extensive hæmothorax	Some hours	Left vent. apex. Non-penetrating
87	GENTIL..... 1901	3 stab wounds in 4th left space	.....	10 hours	Left vent. 1 cm.
88	GERZEN..... 1902	Stab wound in 5th left space	.....	.....	Left vent.
89	GIORDANO..... 1902	Stab wound in 6th left space	.....	.....	Left vent. 2 cm.
90	GIORDANO..... 1902	Stab wound in 3rd, 4th and 5th left spaces, near nipple	.....	.....	Left vent. 2 cm.
91	GOEBELL..... 1906	Pistol-shot wound, 7 mm. in 3rd left space, 2 cm. from sternum. Male; 23 yrs.	Hæmothorax, large amount. Hæmopericardium, 100 c.c. Lung wounded; sutured with catgut	1 hour	Left vent. 2 wounds. 2 cm.
92	GREKOW AND ZEIDLER 1903	Stab wound in 2d left space, 5 cm. from sternum. Male; 25 yrs.	Hæmopneumothorax	3 hours	Left vent. 0.5 cm.
93	GUENOT..... 1904	Stab wound in 4th left space. Female; 20 yrs.	Hæmothorax, 1½ liters	1½ hours	Left vent. near apex. 1.5 cm.
94	GUINARD..... 1904	Stab wound in 4th left space, within nipple line	Hæmothorax, large amount	1½ hours	Left vent.
95	HENRIKSEN..... 1902	Stab wound in 3d left space, 2.5 cm. from sternum	.....	.....	Left vent. 1.5 cm.
96	HESSE..... 1905	Stab wound in 4th left space, near sternum. Male; 13 yrs.	Hæmothorax, large amount	¾ hour	Left vent. ¾ cm.

LEFT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
Flap of 4th, 5th and 6th ribs, hinge external. Chloroform. Continuous catgut sutures	No drainage	No drainage	Pleuritis	Recovered.
Flap of 4th, 5th, and 6th ribs hinge external. Chloroform. Continuous catgut sutures	No drainage	No drainage	Pleuritis; emboli in right lung	Died 5 months later from brain abscess.
Flap of 3rd, 4th and 5th ribs, hinge internal. Pleura freely opened. 3 silk sutures	No drainage	No drainage	Pleuritis; secondary drainage 6 days later	Recovered.
Flap of 3rd, 4th and 5th ribs, hinge internal. Pleura freely opened. Chloroform. 3 silk sutures	.....	.....	.....	Died on table. Autopsy showed a wound of interventricular septum.
Resection of 5th rib. Anæsthesia. 1 suture.	.....	.....	Empyema	Recovered.
Flap of 4th and 5th cartilages, hinge internal. Chloroform. Silk sutures	Drainage	Drainage	.....	Died 5 days later.
Resection of 5th and 6th ribs. Chloroform. Sutured	No drainage	Drainage	Pericarditis; pleuritis; nephritis	Died 53 days later.
Flap of 4th and 5th ribs, hinge internal. 2 silk sutures	No drainage	Drainage	.....	Died 1½ hours later.
Flap of 4th and 5th ribs, hinge external. 2 silk sutures	No drainage	Drainage	Autoplastic operation required to close opening	Recovered.
Flap of 3rd to 7th ribs, hinge external. 9 catgut sutures, 4 in one wound, 5 in the other	Small gauze drain	Gauze drain at lower angle of flap	No complications	Recovered.
Resection of 3rd and 4th ribs. Pleura freely opened. Chloroform. Silk sutures	No drainage	No drainage	Pleuritis, mild	Recovered. Well 10 months later.
Flap of 3rd, 4th, 5th and 6th ribs, hinge internal. Pleura freely opened. Ether. 3 catgut sutures	No drainage	Drainage	Pleuritis	Died 53 hours later.
Flap of 3rd, 4th, 5th and 6th ribs, hinge external. Pleura freely opened. Chloroform. Catgut sutures	No drainage	Drainage	.....	Died 18 hours later.
Resection of 3rd and 4th ribs. Sutured	.....	.....	.....	Died 16 hours later.
Flap of 3rd and 4th ribs, hinge internal. Pleura freely opened. Chloroform. 3 silk sutures	Drainage	Drainage posteriorly by resection of rib	Pericarditis and pleuritis	Recovered.

TABLE II—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age.	Complicating injuries	Time between wounding and operation	Position and size of heart wound
97	HILL..... 1902	Male; colored, 13 yrs.	Hæmopericardium, 10 oz.	.....	Left vent. near apex, ⅛ inch.
98	JANARI..... 1903	Stab wound in 3d left space	Hæmopericardium; heart tamponade	1 hour	Left vent. 1 cm.
99	LAUNAY 1901	Pistol-shot wound, 7 mm. 1 at left nipple. Male; 26 yrs.	Hæmothorax, large amount. Lung wounded	4 hours	Left vent. 2 wounds, entr. and exit
100	LEMAITRE..... 1903	Stab wound in 4th left space, below and internal to nipple. Male; 40 yrs.	Hæmothorax, large amount	1½ hours	Left vent. 4 cm.
101	LONGO..... 1899	Stab wound in 5th left space, 1 cm. outside nipple	.....	½ hour	Left vent.
102	MALIZEWSKI..... 1899	Stab wound in 5th left space, in nipple line. Male; young laborer	Wound of pleura and lung; hæmothorax	½ hour	Left vent. near apex, 2½ cm.
103	MALIZEWSKI..... 1899	Stab wound in 3d left space, outside nipple line. Male; 24 yrs.	Hæmopneumothorax	½ hour	Left vent. 1 cm.
104	MASELLI..... 1900	Stab wound through 6th rib, below and within left nipple	.....	1½ hours	Left vent. near apex
105	MUSUMECI..... 1908	Stab wound in 5th left space, internal to nipple line. Male; 18 yrs.	.....	Not stated	Left vent. near apex, 1 cm.
106	NIETERT..... 1901	Stab wound in 6th left space, inside nipple line. Male; colored, 27 yrs.	Hæmothorax, 1½ pint	14½ hours	Left vent. admitting finger
107	NINNI..... 1898	Stab wound in 5th left space	.....	At once	Left vent. admitting finger
108	NOLL..... 1903	Pistol-shot wound in 1st left space, 7 mm.	.....	1½ hours	Left vent.
109	PAGENSTECHER .. 1899	Stab wound below and within left nipple	.....	16 hours	Left vent. 3.5 cm.
110	PARLAVECCHIO... 1898	Stab wound in 5th left space	.....	8 hours	Left vent. near apex, 3.5 cm.
111	PAROZZANI..... 1897	Stab wound in 7th left space, in nipple line	Left pleura filled with blood	5 hours	Left vent. near apex, 2 cm.
112	PAROZZANI 1897	Stab wound in 3d left space	Wound of interventricular septum	1½ hours	Left vent. 1.5 cm.

LEFT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
Flap of 3rd, 4th and 5th ribs, hinge internal	.....	.....	.....	Recovered.
Flap of 3rd, 4th and 5th ribs, hinge internal. Chloroform. Sutured	Drainage	Drainage	Pleuritis	Died 3 days later.
Flap of 4th, 5th and 6th ribs, hinge external, Pleura freely opened. Chloroform. Both wounds closed with catgut sutures	Drainage	Drainage	.....	Recovered.
Flap of 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Chloroform. 5 catgut sutures	No drainage	Drainage. 2 large drains	.....	Died 9 hours later of hemorrhage and shock.
Flap of 4th and 5th ribs, hinge above. None. 3 silk sutures	.....	.....	.....	Died on table.
Resection of 4th, 5th and 6th ribs. None. 3 silk sutures	No drainage	Gauze drainage	.....	Died 26 hours later.
Resection of 3rd rib. None. 3 silk sutures	Gauze drainage	Gauze drainage	Purulent pericarditis. Pleuritis	Died 4 days later from purulent pericarditis
Resection of 6th rib. No anæsthetic. 2 sutures	No drainage	Gauze drainage	.....	Died 12 hours later.
Triangular flap turned downward, cutting 5th and 6th cartilages. Pleura freely opened. Ether and chloroform. Silk sutures	Gauze drainage	Drainage	Purulent pericarditis. Pleuritis	Died 12 days later from secondary hemorrhage, due to suppuration in myocardium.
Flap of 5th and 6th ribs, hinge internal. Pleura freely opened. Chloroform. 2 silk sutures	Drainage	Drainage	Empyema; thoracotomy 24 days later. Infection of wound	Recovered.
Flap of 4th and 5th ribs, hinge internal. No anæsthetic. 3 sutures	.....	.....	.....	Died on table.
Sutured	Drainage	Drainage	Pleuritis	Recovered.
Resection of 5th cartilage. Ether. 3 deep and 1 superficial suture	No drainage	Drainage	Pleuritis	Recovered.
Resection of 5th rib. Chloroform. 4 sutures	No drainage	No drainage	.....	Recovered.
Flap of 5th, 6th, 7th and 8th cartilages, hinge internal. No anæsthetic. 4 silk sutures	No drainage	No drainage	No complications	Recovered.
Flap of 4th, 5th and 6th ribs, hinge internal. No anæsthetic. 2 sutures	No drainage	No drainage	.....	Died 48 hours after.

TABLE II—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
113	PICONE..... 1904.	Stab wound 2 fingers' breadth below left nipple	.....	Very soon	Left vent.
114	POMARA..... 1902	Stab wound in 6th left space below nipple	.....	.....	Left vent. near apex
115	QUENU..... 1906	Stab wound in 3d left space, near sternum. Female; 19 yrs.	Pericardium distended with blood. Only a little blood in pleura	2½ hours	Left vent., upper part
116	RENON..... 1902	Stab wound in 4th left space, 4 cm. internal to nipple. Male; 23 yrs.	Hæmopericardium; large amount	½–1 hour	Left vent. apex
117	RIBAS y RIBAS... 1905	Stab wound in 3d left space, 3 cm. from sternum	.....	About 1 hour	Left vent. 1 cm.
118	RICHE..... 1904	Pistol shot wound, 8 mm. 5 cm. within and 2 cm. below left nipple. Male; 24 yrs.	Wound of diaphragm, spleen and lung. Very extensive hæmothorax	1½ hours	Left vent. 2 wounds
119	ROSA..... 1899	Stab wound in 5th left space	Wound of lung	At once	Left vent. near base. 1.5 cm.
120	ROTHFUCHS..... 1905	Bullet wound. Male; 25 yrs.	Wound of stomach and diaphragm. Hæmopneumothorax	.....	Left vent. perforated
121	SENNI..... 1905	Stab wound in 6th left space, in nipple line	.....	.....	Left vent. 3 cm.
122	SOMERVILLE 1904	Stab wounds in 4th and 5th left spaces within nipple line. Male	Hæmopneumothorax	55 minutes	Left vent. ragged wound ⅜ inch
123	STEWART, F. T. 1902	Stab wound in 4th left space, ½ inch from sternum	.....	Immediately	Left vent. ⅜ in.
124	STEWART, F. T... 1904	Stab wound in 2d left space, 1 inch from sternum. Male, colored; 20 yrs.	Coronary artery injured during suture. Edge of lung wounded	¾ hour	Left vent. ¾ inch.
125	STEWART, G. D... 1902	Stab wound in 5th left space, ½ in. outside nipple	.....	1½ hours	Left vent. ¾ inch.
126	STUDE..... 1904	Stab wound in chest. Male	.....	2 hours	Left vent. 2.5 cm.
127	SULTAN, C..... 1905	2 stab wounds in 5th left space, 2 cm. within nipple line	Hæmothorax. 1 liter. Wound of right ventricle found at autopsy	.....	Left vent. 7 mm.

LEFT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
Flap of 3rd, 4th and 5th ribs, hinge internal. Sutured	Drainage	Drainage	Hemorrhage into right pleura	Died 2 days later.
Resection of 5th and 6th ribs. No anæsthetic. Silk sutures	No drainage	Drainage	Pericarditis and pleuritis	Died 73 hours later.
Flap of 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Chloroform. 2 sutures	No drainage	No drainage	Syncope on table; traction on tongue revived her	Recovered. Left hospital against advice 12 days after operation.
Resection of 4th and 5th ribs. Chloroform. 4 catgut sutures	.....	.....	.....	Died next day; hemorrhage.
Flap of 4th, 5th and 6th ribs, hinge external. 3 sutures	Drainage	Drainage	.....	Died 72 hours later.
Flap of 3rd, 4th and 5th ribs, hinge external. Pleura freely opened. Chloroform. Both wounds sutured with catgut	.....	.....	.....	Died on table.
Resection of 5th rib. Flap of 6th, 7th and 8th ribs, hinge below. No anæsthetic. 1 suture	Drainage	Drainage	.....	Recovered.
Resection of 4th and 5th ribs. Both wounds sutured with catgut	Gauze drainage	Drainage	Peritonitis	Died 24 hours later.
Flap of 4th, 5th and 6th cartilages and part of sternum. Chloroform. 6 sutures	No drainage	Drainage	.....	Died 3 days later.
Skin flap and intercostal incision in 4th space, not cutting ribs. Ether. 3 silk sutures	Gauze drainage	Drainage	No complications	Recovered.
Ether. 6 catgut sutures	.....	.....	.....	Died 3 days later.
Skin flap hinged external. Flap of 3rd and 4th ribs, hinge internal. 6 continuous silk sutures	Gauze drainage	Gauze drainage	Pneumonia. Wound infection	Recovered.
Resection of 5th rib. Chloroform. 6 sutures	Drainage	Drainage	Pericarditis and pleuritis	Died 2½ days later.
Flap of 4th and 5th left cartilages and part of sternum, hinge on the right. Sutured	.....	.....	.....	Died on table; death attributed to pneumothorax.
Flap of 5th, 6th and 7th ribs, hinge external. 4 sutures	No drainage	No drainage	.....	Died 48 hours later.

TABLE II—WOUNDS OF THE

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
128	SULTAN, C..... 1906	Stab wound in 2d left space, 1 finger's breadth within nipple line	Hæmopericardium, 300–400 c.c.	5 days	Left vent.
129	SULTAN, G..... 1907	Pistol shot wound, 9 mm. in 5th left space, inside nipple line. Male; 38 years	Hæmopericardium, 200 c.c.	30 hours	Left vent. non-penetrating. 1½ cm.
130	TIKHOFF..... 1908	Stab wound with long, bent shoemaker's needle, outside nipple line. Male; 55 yrs.	Hæmopericardium; marked heart tamponade	1½ hours	Left vent. posterior aspect
131	TSCHERNIACHOWSKI..... 1904	Stab wound in 4th left space, 1 finger's breadth internal to nipple. Male; 24 yrs.	Wound in lung; sutured	Less than 1 hour	Left vent. 5 cm. above apex. 1.5 cm.
132	TUZZI..... 1899	Stab wound in 4th left space near sternum	.....	.....	Left vent. 2 wounds, one penetrating
133	VAUGHAN..... 1901	Stab wound dividing 5th costal cartilage. Male, colored; 23 yrs.	2000 c.c. of blood in pleura and pericardium	¾ hour	Left vent. 2½ cm.
134	VELO..... 1902	Stab wound in 6th left space in nipple line. Male; 56 yrs.	Pleura filled with blood. Hæmopericardium, large amount	½ hour	Left vent. apex non-penetrating. 1.5 cm.
135	VIDAL..... 1908	Bullet wound (Flobert rifle) in 4th space, 10 cm. from median line. Male; 11 yrs.	.....	1½ hours	Left vent.
136	VINCE..... 1903	Stab wound in 5th left space	.....	12 hours	Left vent.
137	WALCKER..... 1900	20 stab wounds, most of them in 4th left space	Extensive hæmothorax	4 hours	Left vent. 2 wounds, 8 heart wounds in all
138	WEINLECHNER... 1904	Stab wounds in 3d and 4th left spaces, within nipple line. Male	.....	Very soon	Left vent. 2 wounds, 5 mm.
139	WENDEL..... 1905	Stab wound in 4th left space near sternum. Male; 19 yrs.	.....	5 hours	Left vent.
140	WENNERSTROM .. 1903	Wound from fragment of glass in 3d left space, near sternum	.....	2 hours	Left vent. 2 cm.
141	WILMS..... 1906	Pistol shot wound, 6 mm.	Wound of lung, perforating, both wounds sutured. Hæmothorax, 1½ liters	2 hours	Left vent. perforated
142	DE ZAWADSKI.... 1907	Stab wound	.....	.....	Left vent. posterior face
	RIMANN 1909	Gunshot wound perforating 3d rib. Male; 20 yrs.	Hæmopericardium; 100 c.c. Heart tamponade	1½ hours	Left vent.

LEFT VENTRICLE—*Continued*

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Results and remarks
	Pericardium	Pleura		
Flap of 3rd, 4th and 5th ribs, hinge internal. Silk sutures; first tore out, others placed farther from edge	Drainage	No drainage	.....	Recovered.
Flap of 4th and 5th left cartilages and part of sternum; hinge on the right. Pleura not opened. Chloroform. 3 silk sutures	.....	.....	No complications	Recovered.
Resection of 4th and 5th ribs. Pleura opened. Anæsthesia (very light). One suture	Edges sutured to skin; packed with gauze	.....	Slight suppuration in pericardial wound	Recovered. Left hospital completely healed 26 days after operation.
Wound enlarged; 4th cartilage and part of sternum resected. Pleura opened. Chloroform. 3 silk mattress sutures	Iodoform gauze drain	Gauze tampon	No complications	Recovered. Left hospital 6 weeks after operation.
Resection of 4th and 5th ribs. No anæsthetic. Sutured	No drainage	Drainage	Pericarditis, serofibrinous empyema	Died 22 days later.
Flap of 4th and 5th ribs, 7 cm. wide, hinge upward. Ether. 7 continuous silk sutures	.....	.....	.....	Died on table; hemorrhage.
Resection of 5th and 6th ribs. Pleura freely opened. 3 catgut sutures	Drainage	Drainage	Pleuritis	Died 3 days later. Autopsy: myocardium soft and hypertrophied.
Incision in 3rd left space, without resecting ribs, under positive pressure. Pleura freely opened. Ether. 2 sutures	No drainage	No drainage	.....	Recovered.
Flap of 5th, 6th and 7th ribs. Chloroform. 3 silk sutures	No drainage	.....	.....	Died next day.
Resection of 4th rib. 11 silk stitches	Drainage	Drainage	.....	Died 1½ days later.
Resection of 5th rib. Chloroform. Silk sutures	Drainage	Drainage	Pericarditis and pleuritis	Died 49 hours later.
Flap of 4th and 5th cartilages, hinge external. Pleura not opened. Chloroform. 1 catgut suture	Drainage	.....	Pericarditis	Recovered.
Resection of 4th, 5th and 6th cartilages. 1 catgut and 4 silk sutures	No drainage	Drainage	3 gauze sponge pads left in pleura; removed on 14th day	Recovered.
Intercostal incision in 4th space. Both wounds sutured. 3 sutures in each	No drainage	No drainage	No complications	Recovered.
Ether. Sutured	Drainage	.....	Suppurative pericarditis. Wound infection	Died 15 days later from secondary hemorrhage, due to suppuration in heart wound.
Resection of 4th and 5th cartilages. Ether. 5 silk sutures	No drainage	No drainage	Serous pleuritis; aspiration 12 days after operation	Recovered.

TABLE III—WOUNDS

No.	Operator. Year	Location and character of external wound. Sex. Age	Complicating injuries	Time between wounding and operation	Position and size of heart wound
143	GENTIL..... 1901	Male; 28 yrs.	.....	5 hours	Right auricle. 1 cm.
144	GIORDANO..... 1898	Stab wound in 2d left space	.....	½ hour	Left auricle. 2 cm.
145	GIULANIO..... 1903	Stab wound in 3d left space in nipple line	.....	.....	Left auricle
146	HARTE..... 1906	Stab wound in 3d left space	.....	.....	Left auricle. ½ inch
147	KAPPELER..... 1904	Stab wounds over 3d rib and in 3d left space	.....	2½ hours	Left auricle. 1 cm.
148	NINNI..... 1901	Stab wound in 3d left space, near parasternal line	Hæmopericardium, large amount	½ to 1 hr.	Right auricle near auriculo vent. groove. 2.5 cm.
149	PECK..... 1908	Stab wound through 3d left cartilage at border of sternum. Female, colored; 23 yrs.	Two superficial stab wounds. Hæmopericardium; marked heart tamponade	¾ hour	Right auricle. 1 cm.
150	SCHWERIN..... 1903	Sharp pointed body entered 4th left space	.....	¾ hour	Right auricle
151	THIEMANN..... 1906	Needle 31 mm. in tissues, fixed at upper border of 4th rib. Male; 23 yrs.	Hæmopericardium, 100 c.c.	4 hours	Right auricle. 1.5 cm. Right vent. 1 cm.
152	WILMS..... 1907	Stab wound. Male; 27 yrs.	Hæmothorax, 3 pints. Hæmopericardium, 50 c.c.	16 hours	Left auricle
	*DUFFY..... 1908	Stab wound dividing 4th cartilage. Male; 23 yrs.	Wound of lung and pleura. Hæmopneumothorax	½ hour	Right auricle. ⅛ inch

*Personal communication from Dr. Edward F. Duffy, Yonkers, N. Y. (unpublished).

TABLE IV—MISCELLANEOUS

153	BARDENHEUER... 1904 (?)	Gunshot wound	.....	.....	Heart perforated
154	BORZYMOWSKI ... 1903	Stab wounds over 5th left cartilage. Male; 19 yrs.	Wound of pleura; sutured	.....	3 heart wounds
155	BRACHINI..... 1901	Stab wound in 4th left space, 3 cm. outside nipple. Male; 15 yrs.	Hæmopericardium, large amount	Soon	Interventric groove. 2 cm.
156	MAUCLAIRE..... 1903	Stab wound, of left breast, 3 cm. from sternum	.....	.....	Heart wound
157	PAGENSTECHER .. 1901	Stab wound in 4th left space, 1 cm. from sternum. Male; 30 yrs.	.....	2½ hours	Left coronary artery divided
158	SCHUBERT..... 1904	Bullet wound in 4th left space	.....	½ hour	2 heart wounds, one anterior and one posterior
159	ZIEMBISKI..... 1903	Stab wound	.....	.....	Heart wound

OF THE AURICLES

Operative procedure. Anæsthetic. Sutures	Drainage		Course and postoperative complications	Result and remarks
	Pericardium	Pleura		
.....	.....	.....	.....	Recovered.
Flap of 3rd and 4th ribs, hinge below. No anæsthetic. 4 silk sutures	No drainage	Drainage	Left pleuritis. Right pulmonary abscess	Died 18 days after operation.
Flap of 3rd and 4th ribs, hinge external. Sutured with silk	Drainage	Drainage	.....	Recovered.
Resection of 3rd and 4th cartilages. Ether. Catgut sutures	No drainage	Drainage	Pleuritis. Double pneumonia	Died 24 days after operation
Flap of 3rd and 4th ribs, hinge internal. Ether. Sutured	.....	Drainage	Pleuritis	Recovered.
Resection of 4th and 5th cartilages and part of sternum. No anæsthetic. 3 sutures	Drainage	Drainage	Pericarditis and pleuritis	Died 3 days later.
Flap of 3rd, 4th and 5th ribs, hinge external. Resection of part of sternum. Pleura not opened. Ether. 4 chromicized catgut sutures	No drainage	No drainage	Pleuritis, mild, nonsuppurative	Recovered.
Resection of 4th and 5th cartilages. 3 silk sutures	Drainage	Drainage	Pericarditis, pleuritis and pneumonia	Recovered.
Resection of 4th and 5th ribs. Chloroform. 4 catgut sutures in auricle, 1 catgut suture in ventricle	Drainage	Drainage	Pericarditis, pleuritis and empyema	Recovered. Case also included in table of right ventricle wounds No. 60.
Intercostal incision in 3rd space, resection of 1⅛ inch of 3rd rib	Drainage	No drainage	Pericarditis, pleuritis and empyema	Recovered. Out of bed in 3 weeks.
Quadrangular flap of 3d, 4th and 5th ribs, hinge external. Ether. 3 plain catgut sutures	No drainage	No drainage	Septic pericarditis; double pleuritis; pneumonia	Died 19 days later of general sepsis.

HEART WOUNDS

Both entrance and exit wounds sutured	.....	.....	Pericarditis and pleuritis	Died 3 days later.
Ether. All three wounds closed with silk sutures	.....	.....	Severe sepsis; suppurative pericarditis; discharge of silk sutures. Empyema—thoracotomy, 3rd rib, 6 months later	Recovered.
Flap of 2nd, 3rd, 4th and 5th ribs, hinge internal. Pleura opened. No anæsthetic. 5 silk sutures	.....	Drainage	Pericarditis and pleuritis, purulent	Died 42 hours later, due to infection of pleura and pericardium.
Flap of 3rd and 4th ribs. 3 sutures	Drainage	Drainage	.....	Died 24 hours later.
Flap of 4th and 5th cartilages, hinge internal. Ether. Both ends of divided artery secured with sutures	.....	.....	Pericarditis and pleuritis	Died 4 days later.
Resection of 4th rib. Chloroform. Both wounds sutured with catgut	.....	.....	.....	Recovered. Operator thought bullet went through interventricular septum without opening either ventricle.
Sutured	.....	.....	.....	Died.

teriorly by separate rib resection as in empyema, and not through the operative wound. If the lung is collapsed from the pneumothorax, aspiration drainage could be employed.

Careful suture of the soft parts should be made to prevent the sucking in of air through accidental or intentional operative wounds of the pleura. Any attempt to draw conclusions as to the effect of drainage as regards infection in reported cases seems rather hopeless, as the percentage of infected cases in the drained and the non-drained cases does not differ greatly. The fact that so large a percentage of the fatal cases (more than 60 per cent.) have escaped the first danger of hemorrhage and shock, and have succumbed later from other causes, generally of infective origin, leads to the hope that the future will show a substantial diminution in the mortality of cases operated upon.

Already one recent heart wound has been sutured under positive pressure (Vidal, Case 136).

Resection of a portion of one or more ribs without flap formation has been frequently done with satisfactory results.

The quadrangular flap with hinge external and *the long intercostal incision* with division of one or more cartilages at their sternal attachments, seem to me the best methods. For wounds far to the right, removal of a part of the sternum could be added to either method.

To gain sufficient experience by operations upon the human subject is out of the question. It is necessary, therefore, for every surgeon to whom such an opportunity may come, to be prepared to meet it at a moment's notice. A well formed plan of action, rehearsal of the technic if possible on the cadaver, together with the knowledge to be gained by the study of original case reports and experimental work, will be of inestimable value to the surgeon who may be called upon to meet this important emergency.

NOTE.—No attempt has been made to analyze exhaustively all the facts contained in the Tables, page 108 to 129. References are given as completely as possible to original case reports, which are replete with interesting and instructive de-

tails quite worthy of perusal. Cases incorrectly included or reduplicated in previously published series have been excluded as far as possible; *e.g.*, the case of Brenner, which has been published as three separate cases credited to Brenner and Zulehener. No effort has been made to include in the Bibliography all important contributions to the subject of heart surgery.

BIBLIOGRAPHY.

[1] Alvez de Lima: Gazett. Clin.; S. Paula, 1905, iii, 386.

[2] Bardenheuer: Allegemein. Aertzl. Verein zu Koln, 1904, July 4, Munch. med. Woch., 1904, No. 34, 1534.

[3] Barth (reported by Wolff): Deutsche Zeitsch. f. Chir.; Leipzig, 1903, lxix, 67.

[4] Baudet: Bull. et Mém. Soc. de Chir. de Paris, 1907, n. s., xxxiii, 10.

[5] Bayha: Med. Corr. d. Wurtem. arztl. Land., 1908, lxxviii, 477.

[6] Blake: ANNALS OF SURGERY, Philadelphia, 1908, xlviii, 138.

[7] Borchardt: Sammlung. klin. Vortrage, Leipzig, 1906, N. f. Chir. 102–127, p. 297. (Nos. 411, 412; Chir. 113, 114.)

[8] Borzymowski: Medycyna, Warsaw, 1904, xxxii, 506, 622.

[9] Bougle: Bull. de la Soc. Anat. de Paris, 1901, lxxvi, 122.

[10] Brachini (rep. by A. Liscia): Clinica Chirurgica, Milano, 1901, Aug. 31.

[11] Brenner (rep. by Zulehner): Wiener klin. Woch., 1901, xiv, 263.

[12] Brezard et Morel: Bull. de la Soc. Anat. de Paris, 1905, lxxx, 835.

[13] Bufnoir: Bull. et Mém. Soc. Anat. de Paris, 1899, lxxiv, 65.

[14] Camus: Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 80 and 676.

[15] Cappelen: Norsk. Mag. f. Laegev., Kristiana, 1896, 4, R., xi, 285.

[16] Capello-Cimorini: Bull. d. Soc. Lancisiana d'osp. di Roma, 1904, xxiv, 239.

[17] Carmelo: Clinica Chirurg., Milano, 1905, 103.

[18] Carnabel: Bull. et Mém. Soc. de Chir. de Bucarest, 1900–1901, iii, 144.

[19] Chastenet de Gery: Gaz. Méd. de Nantes, 1908, xxvi, 651.

[20] Del Vecchio: Riforma Med., Napoli, 1895, xi–ii, 38.

[21] Dolcetti: Centralblatt. f. Chir., Leipzig, 1906, xxxiii, 566.

[22] Duval: Bull. et Mém. Soc. de Chir. de Paris, 1907, xxxiii, 15.

[23] Elsberg: Jour. Exper. Med., N. Y., 1899, lv, 479.

[24] Farina: Trans. xi, Ital. Cong. Surg., 1896, Rome.

[25] Fischer, E.: Ungar. Med. Press, Budapest, 1907, xii, 19.

[26] Fittig, O.: Beitrag. zur klin. Chir., Tubing., 1907, lx, 567.

[27] Fontan: Bull. et Mém. Soc. de Chir. de Paris, 1900, xxvi, 492; ibid., xxvii, 1099, 1901.

[28] de Fourmestraux: Bull. et Mém. Soc. de Chir. de Paris, 1905, xxxi, 818; Bull. Soc. Anat. de Paris, 1906, lxxxi, 316.

[29] Fummi (in Ramoni): Bull. d. Soc. Lancis. d. osp. di Roma, 1899, xix.

[30] Gaudemet: Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 142.
[31] Gentil: Rev. portug. de med. e Cirurg., Lisbon, 1901, x, 353; Med. contemp., Lisbon, 1904, 2. s. xi, 109, 111.
[32] Gentil: Congr. internat. de méd., Lisbon, 1906, sec. ix, 446.
[33] Gerzen: Medizinsk. Obosrenije, Mosk., 1904.
[34] Gibbon: Phila. Med. Jour., 1902, Nov. 1; Tråns. Coll. Phys., Phila., 1905, s. 3, xxvii, 213.
[35] Giudice: Pammatone, Genoa, 1905, ix, 74.
[36] Giordano: La Riforma Medic., 1898, xiv, iii, 674; La Chirurgia del pericardio e del Cuore, 8, Napoli, 1900; Gazz. d. osp., Milan, 1903, xxiv, 49.
[37] Giulanio: Gazz. d. osp., Milan, 1905, xxvi, 322.
[38] Goebell: Verhand. der Deutsch. Gesellsch. f. Chir., 1906, xxxv, ii, 70.
[39] Grassman: Munch. med. Woch., 1908, lv, 2379.
[40] Grekow and Zeidler: Centralblatt. f. Chir., 1905, 588; Russ. Archiv. f. Chir., 1904, xx, 974 (St. Peterb.).
[41] Guenot: Bull. et Mém. Soc. de Chir. de Paris, 1905, xxxi, 392; Bull. Méd., Paris, 1904, xviii, 585.
[42] Guinard: Bull. et Mém. Soc. de Chir. de Paris, 1904, xxx, 705.

[42](*a*) Haecker: Archiv. f. klin. Chir., Berlin, 1907, lxxxiv, 1035.
[43] Harte: ANNALS OF SURGERY, Phila., 1907, xlv, 672.
[44] Henriksen: Norsk. Mag. f. Laegev., Kristiana, 1902, lxiii, 1023.
[45] Hesse: Sitzung. d. phys. med. Gesellsch zu Wurz., 1906, p. 2–5; ibid., 92, 1905.
[46] Hill: Med. Record, N. Y., 1902, lxii, 846.
[47] Horodynski: Medycyna, Warsaw, 1899, xxvii, Nos. 21 and 22, 460, 528.

[48] Isnardi and Colombino: Giorn. d. R. Acad. di Torino, 1903, Nos. 4 and 5.

[49] Janari: Policlinico, Roma, ser. Chir., 1903, No. 5.

[50] Kappeler: Deutsch. Zeitsch. f. Chir., 1904, lxxii, 603.
[51] Kosinski: Kronika Lekarska, 1899; Jahresbr. f. Chir., 1899.
[52](*a*) Kronecker and Schmey: Sitzungsb. der Akad. der Wissench. zu Berlin, 1884.

[52] Lastaria: Riforma Med., Rome, 1901, xvii, i, 808.
[53] Launay: Bull. acad. de med. de Paris, 1902, xlviii, 185.
[54] Lemaitre: Bull. Soc. Anat. de Paris, 1903, lxxviii, 575; Thèse de Paris, 1905.
[55] Lenormant: Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 681; Gazette des Hopitaux, 1906, lxxix, 1239.
[56] Liscia: Clinica Chir., Milan, 1901, ix, 674.
[57] Longo: Gazz. d. osp., Milan, 1899, xx, 229.

[58] Malizewski: Medycyna, Warsaw, 1899, xxvii, Nos. 21 and 22, 469, 528.
[59] Manteuffel: Centralblatt f. Chir., 1905, xxxii, 1096.
[60] Marion: La Presse Méd., 1899, vii, 148.

[61] Maselli: Policlinico, Rome, 1899–1900, vi, 1345; Bull. d. Soc. Lancis, d. osp. di Roma, 1900, xx, 164.
[62] Mauclaire: Russk. Archiv. Chir., 1903, 1131.
[63] Mignon et Sieur: Bull. et Mém. Soc. de Chir. de Paris, 1901, xxvii, 422.
[64] Milesi: Policlinico, Roma, 1904, xi, 1274.
[65] Morestin: Archiv. gen. de Med., 1903, ii, 2380.
[66] Musumeci: Clinica Chir., Milan, 1905, xiii, 641; Clinica Chir., Milan, 1908, xvi, 292.

[67] Nanu: xiii Congr. Internat. de Med., Paris, 1900, x (chir.), 602.
[68] Neumann: Deutsch. med. Woch., Leipzig and Berlin, 1898, xxiv, Ver. Beil., 90; Berlin, klin. Woch., 1905, xlii, 643.
[69] Nicolai (in Ramoni): Gazz. Med. di Roma, 1899, xxv, i, 29.
[70] Nietert: Interstate Med. Jour., 1901, 563; Interstate Med. Jour., 1902, 5.
[71] Nimier: Archiv. de Méd. et de Pharm., Milit., 1906, xlvii, 209.
[72] Ninni: Atti. d. R. Acad. Med. chir. di Napoli, 1898, lii, 320; ibid, lv, No. 3, 1901.
[73] Noll: Verhandl. Deutsch. Gesellsch. f. Chir., 1903, xxxii, 168.

[74] Pagenstecher: Deutsch. med. Woch., Leipzig and Berlin, 1899, xxv, 523; ibid., xxvii, 56, 1901.
[75] Parozzani: Bull. d. R. acad. Med. di Roma, 1896, 7, 243.
[76] Peck: Annals of Surgery, Phila., 1909, xlix, 135.
[77] Pecori: Policlinico, Rome, 1902–3, ix–x, 501.
[78] Picone: Clinica Chirurg., Milano, 1904, xii, 1129.
[79] Pomara: Gazz. d. Osp., Milan., 1902, No. 129.

[80] Quenu: Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 316.

[81] Ramoni: Gazz. Med. di Roma, 1899, xxv, i, 29.
[82] Rehn: Verhandl. Deutsch. Gesellsch. f. Chir., 1897, xxvi; Archiv. f. klin. Chir., 1907, lxxxi, 723.
[83] Renon: Tribune Med., Paris, 1904, n. s., ii, 39.
[84] Ribas y Ribas: Rev. de med. y cirurg., Barcelona, 1906, xx, i.
[85] Riche: Bull. Soc. Anat. de Paris, 1904, lxxix, 370; Bull. et Mém. Soc. de Chir. de Paris, 1905, xxxi, 172.
[85] (*a*) Munch. med. Woch., 1909, April 13.
[86] Rosa: Clin. Chir., Milan, 1899, vii, 836; Policlin., Rome, 1900–1901, vii, sez. prat., 449.
[87] Rothfuchs: Deutsch. zeit. f. Chir., 1905, lxxvii, 603.

[88] Savariaud: Congres français de Chirurgie, 1902; Bull. et Mém. Soc. de Chir. de Paris, 1906, xxxii, 319.
[89] Schakhovskoi: Russk. Khirurg. Obozr., Mosk., 1903, i, 589.
[90] Schubert: Deutsch. Zeitschr. f. Chir., 1904, lxxv, 71.
[91] Schwerin: Verhandl. d. Deutsch. Gesellsch. f. Chir., Ber., 1903, xxxii, i, 166–168.
[92] Senni: Clinica. Chir., Milan, 1903, xi, 1067.
[93] Smith: Southern Cal. Pract., 1904, xix, 337.

[94] Soave: La Riforma Med., 1908, xxiv, 121.
[95] Somerville: Lancet, Lond., 1904, 1278.
[96] Spangaro: Clinica Chir., Milan., 1906, xiv, 227.
[97] Stewart, F. T.: Am. Jour. Med. Soc., Phila., 1904, cxxviii, 432.
[98] Stewart, G. D.: Personal Communication.
[99] Steyner: Panietnik. Lekarsk., Warsaw, 1903.
[100] Stude: Deutsch. Militär. ärztl. Zeitschr., 1904, xxxiii, 20.
[101] Sultan, C.: Verhandl. der Deutsch. Gesellsch. f. Chir., 1906, xxv, 125.
[102] Sultan, G.: Deutsch. med. Woch., 1908, xxxiv, 277.

[103] Thiemann: Archiv. f. klin. Chir., 1907, lxxxiii, 565.
[104] Tikhoff: Khirurgia, Mosk., 1908, xxiii, 485.
[105] Travers: Lancet, Lond., 1906, ii, 706.
[106] Tscherniachowski: Deutsch. Zeitsch. f. Chir., 1906, lxxxiii, 288.
[107] Tuzzi (in Ramoni): Gazz. Med. di Roma, xxv, i, 29.

[108] Vaughan: Med. News, 1901, Dec. 7, p. 881. Jour. Amer. Med. Assoc., 1909, lii, 438.
[109] Velo (Terrier et Reymond): Rapport au Congres français de Chirurgie, 1902.
[110] Vidal: Vingt-et-unième Congr. de Chir. de Paris, 1908, 637.
[111] Vince: Jour. de Chir. et Ann. Soc. belge de Chir., Brux., 1903–4, iii, 198–202.
[112] Vogel: Centralblatt f. Chir., 1904, xxxi, 683.

[113] Walcker: Berlin. klin. Woch., 1900, xxxvii, 1193; Deutsch. zeitschr. f. Chir., Leipzig, 1900, lviii, 105.
[114] Watten: Deutsch. med. Woch., 1901, xxvii, 627; Gazz. lek., Warsaw, 1900, v. s., xx, 963.
[115] Watts (quoted by Vaughan): Jour. A. M. A., 1909, lii, 438.
[116] Weinlechner: Wiener Klinik, 1904, 146.
[117] Weiss: Rev. méd. d. l'est, Nancy, 1905, xxxvii, 504.
[118] Wendel: Verhandl. Deutsch. Gesellsch. f. Chir., 1906, xxxv, 215.
[119] Wennerstrom: Upsala Lak. Fordhand., viii, 1903; Centralblatt f. Chir., 1903, 1055.
[120] Wilms: Centralblatt f. Chir., Leipzig, 1906, xxxiii, 817.
[121] Wilms (by Meerwein): Munch. med. Woch., 1907, liv, 1784.

[122] de Zawadski: Vingtième Congr. de Chir. de Paris, 1907, 234.
[123] Ziembiski: Przeglad, Lekarsk., 1903, 600.

THE OPERATIVE TREATMENT OF TUBERCULOSIS OF THE LUNGS WITH TOTAL THORACOPLASTIC PLEUROPNEUMOLYSIS.*

BY P. L. FRIEDRICH.

OF MARBURG, GERMANY,

Professor of Surgery in the University of Marburg.

If I presume to discuss before this illustrious assembly the subject of the operation of lung tuberculosis, it is because the matter is comparatively new on the one hand, while on the other it has provided me with a measure of personal experience such as to justify one in claiming the interest of wider professional circles for this pending problem. Having availed myself of various opportunities in Germany, for this purpose, I appreciate it as an especial distinction and privilege now to submit our experience.

Through an especially favorable coincidence, I had been engaged for several years upon experimental studies concerning the compensation of space in the thoracic cavity after the removal of an entire lung, while my colleague of the Internal Department, Professor Brauer, in his detailed studies of the treatment of tuberculosis with artificial pneumothorax, felt the necessity of more radical surgical measures.

In these experiments, I showed not only that the ablation of one lung is readily tolerated by animals immediately after the interference, but I ascertained also their excellent condition later, in regard to increase in body weight and further growth. The most important feature of these experiments was, that when the animals were killed, a long time after (one to one and a half years), the cavity caused by the removal of the lung was found to have become perfectly compensated—the heart taking the place of the pulmonary defect, in right-sided

* Read before the American Surgical Association, June 4, 1909.

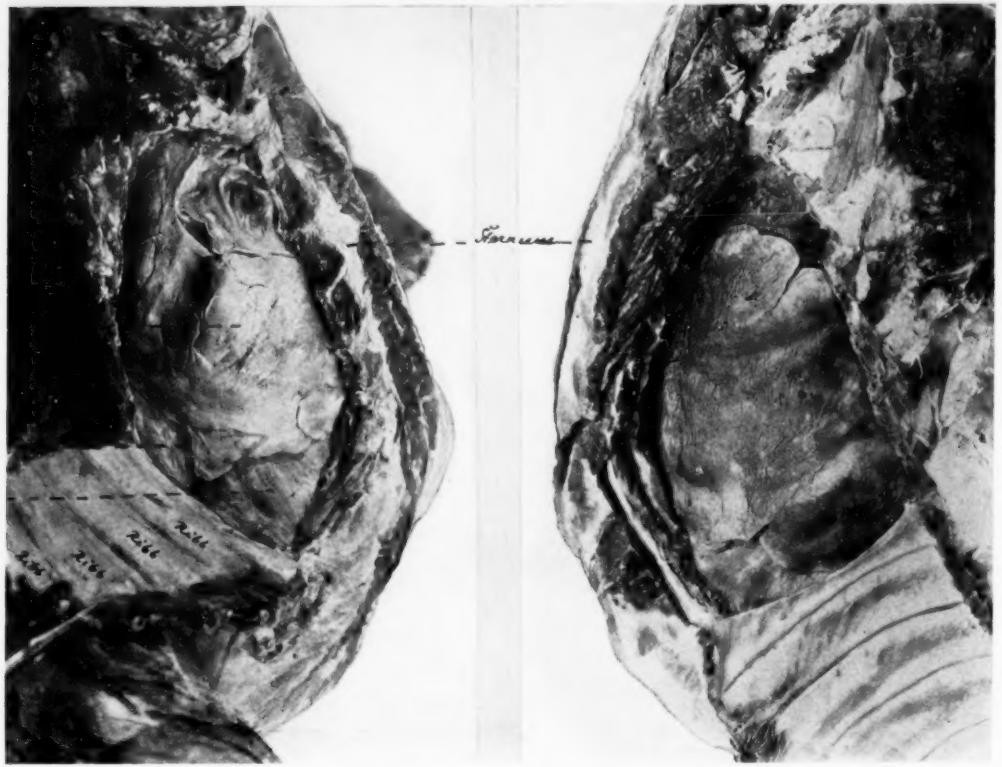
as well as left-sided amputation of the lung; and also that the remaining lung shows not only an increase in volume, but in a small portion even fills the defect left by the heart on the amputated side (Fig. 1). Moreover, the diaphragm at the site of the operation helped to diminish the defect, by rising higher up. The ribs on the operated side undergo atrophy, without a rib having been injured at the operation, to such an extent that the chest-wall itself *helps to diminish the defect by becoming flattened and shrunken.* I present a series of corresponding photographs, so that those among you who are interested in this matter, may inspect the specimen photographs directly.

In addition to this, I was enabled to observe, in my former clinic in Greifswald, in a patient with extensive tuberculosis of the lungs and ribs, a favorable influence upon the pulmonary tuberculosis which astonished myself and my assistants, after ablation of almost the entire bony wall of the thorax on the diseased side. Thereupon, when my colleague in internal medicine referred to me cases in which pneumothorax therapy proved a failure on account of mutual adhesions of the pleural layers, we determined, after reviewing the various possibilities of surgical intervention, to assist the tendency of a still youthful lung toward shrinkage, with tuberculous cavernous destructive processes, in such a way that I de-ossified, as it were, the thoracic wall by ablating the ribs from the second to the tenth, from the spinal column as far as the costal cartilage at the sternum, the lung thus being made to collapse towards the hilus.

The course of our procedures was described last year, in an article published in *Surgery, Gynæcology and Obstetrics.* At the present day I am in a position to look back upon a measure of experience which permits me to outline more sharply the indications for this interference; to state how its dangers are most efficiently managed; and, finally, to specify the total results of the operation.

In adopting this course we stood by no means alone, but

FIG. 1.



Total amputation of the right lung. Dog, killed one year and a half after the operation. Right side of the thorax contains the heart, a little part of the left lung and diaphragm. Left side of the thorax contains only the left lung.

(as I have always pointed out in grateful acknowledgment of their scientific and practical preliminary labors) Quincke, Spengler, Turban, and Landerer had previously suggested that in all cases of unilateral phthisis showing a tendency to shrinkage of the lung, or over cavernous lung segments in general, the natural mechanism of the shrinking process, that caused the lung which was maintained at a certain rigid tension, to collapse through the removal of the ribs should be further reckoned with.

The same idea underlies the attempts of Forlanini, Murphy, Lemcke and Schell, Brauer, and A. Schmidt, to induce a restriction in the volume of the lung through the production of artificial pneumothorax.

The ablation of the bony chest wall must be carried out rapidly and accurately,—and this act can be completed within thirty to forty minutes, under employment of very small amounts of anæsthetic (0.015 morphine, local anæsthetic injections, and 6–10 gr. chloroform). The atmospheric pressure on the elastic chest wall now merely consisting of soft parts, then leads immediately to a very complete collapse-effect upon the lung, similar to pneumothorax. Only in case the lung contains calcified or dense fibrous masses in its interior, or when a former pleuromediastinitis has raised a sort of solid resistant rampart in a mesial direction, is the immediate retraction of the lung not so evident. Also the reaction upon the heart, in regard to displacement as well as change of the pulmonary circulation, is not so marked in these cases. At any rate, however, the intervention leads to (1) collapse of cavernous lung tissue; (2) extensive exclusion of the lung on the operated side from the respiratory function; (3) retardation of the pulmonary circulation in this lung; (4) through the arrest of breathing in this lung, an essential diminution of the lymphatic circulation and absorption.

The natural results of the interference are, in the first place, a considerable taxation of the opposite lung for the respiratory function. Very promptly a compensatory increase of

volume is developed in this lung,—as I am enabled to demonstate to you in the series of pictures which I present (Fig. 6).

Whether this immediate increase in volume of the other lung develops in the further course into a compensatory emphysema, or whether the increased functional activity is followed by genuine hypertrophy of lung tissue—as in other paired organs of the body—cannot yet be positively determined, as none of the operated patients have died at the end of a long time, so that the question could be settled on the autopsy table. Here again our current experimental work enters into consideration. At any rate, the problem is of great theoretical and practical interest, and it requires very careful investigation.

It cannot as yet be considered as definitely settled, and there are sure to be certain differences in the course taken by individual cases, in how far tuberculous foci of the side not operated upon will undergo a more rapid evolution, or be affected in a favorable way. In several cases, slight aggravations were noted immediately after the operation, but we never had a regrettable acceleration of the general course, or a death; on the contrary, we became convinced that in the majority of the cases the foci on the opposite side are favorably influenced. An unconditional preliminary requirement for admission to the operation is to select *only such cases of unilateral phthisis in which the other side is not simultaneously affected with active progressive foci, passive* processes alone being present. In the further course, it may prove harmful, as was noted in two of our cases, that the de-ossified chest wall remains permanently boneless. In the first of our cases, we considered it as an object of the operation to ablate the retrocostal periosteum as completely as possible, and to make the pleura yield. Through the above experience, we have been led to *leave the retrocostal periosteum behind,* at present. It is then in our power to render the shrinkage of the lung very thorough within a few months, under simultaneous light pressure upon the operated side. After this period of shrinkage, the re-establishment of

periosteal ossification is desirable, in order to counteract the bulging out of a still inflatable portion of lung in the act of coughing. A case among our latest observations, in which this regeneration has occurred in all of the ribs, belongs to the most favorable results of our treatment.

I have recently gone a step further, in the mobilizing and loosening of the lung tissue, by detaching separately in the course of the operation the pulmonary *apex,* together with the overlying costal pleura from the entire surroundings, or by removing the first rib also, thereby rendering the apex of the lung more shrinkable. As showing the shrinkage of the lung in our recent patients taking place in the course of several months, I will mention particularly two cases. In one we had to deal with a rapidly progressive and at the same time infiltrating tuberculosis; and in the other a badly weakened, desperately ill patient, with extremely severe, highly febrile right-sided phthisis. I adhered to my mode of incision in all the total pleuropneumolyses, limiting myself only in the case of female patients to a predominantly posterior incision with full preservation of the breast. In my last cases, I detached the apex of the lung by itself and endeavored to induce its shrinkage. The radiographs show how markedly the first rib gradually descends in our operated cases, becoming displaced mesially, and together with the soft parts of the shoulder, the clavicle and the scapula, furthers the restriction in volume of the pulmonary apex. In my most radical procedure of de-ossification of the chest-wall, the first rib had always been preserved, in consideration of the fact that its removal adds considerably to the length of the operation, increases the technical difficulties, and thus heightens the risk run by the patient. Blunt subcostal detachment, on the other hand, may be carried out quickly, easily and without damage (apicolysis). The total structure of the lung apex is thus rendered still more susceptible to shrinkage. My original intention in these two cases (October and December, 1908), was to remove the first rib also; but the difficulty of

enucleating the rib induced me to adopt the conservative procedure of *subcostal apicolysis.* In the absence of old periosteal inflammations of the ribs, as a sequel to *apicopleuritis,* as existant in the above two cases, the ablation of the first rib is not, however, attended with special difficulties. The first skin-muscle-flap incision should be *carried up higher in the posterior circumference,* and the plastic flap be pushed gently away until beyond the first rib; the subclavian artery and vein are suspended in the flap; the anterior and posterior scaleni are transversely divided with the knife at their costal insertion, or detached by blunt dissection. The insertion of the scaleni may be very firm; they do not necessarily follow the periosteum as it is levered off. The first rib can now be raised with my rounded elevator, and removed like any other rib. It goes without saying, that the ablation of the first rib induces the most thorough shrinkage of the pulmonary apex. In a case which was recently operated upon, I removed the first rib also.

Several cases have caused me to try circumscribed costal ablations when the lesion concerned exclusively the lower lobe or the upper lobe, and was apparently circumscribed. In a general way, however, I wish to summarize the result of these operations, to the effect that it will always prove advisable to *extend the scope of the operation considerably beyond what seems to be required by the extent of the lesion.* The reason for this is, that the collapse of the lung takes place to a relatively slight extent only when the number of the ablated ribs is not considerable, and the individual ribs have not been completely removed. The continuity of the costal pleura prevents the lung from sinking in as far as desired.

As has been pointed out in my last publications, the cases should be *strictly selected,* and *only* those patients operated upon who have *unilateral* cavernous lesions, with at most *passive* foci on the opposite side. They must be free from evident recent tuberculous processes in other regions of the body, more particularly the bowel.

STATISTIC TABLE.—A. UNILATERAL LUNG PHTHISIS. TOTAL PLEURO-PNEUMOLYSIS. (II–X RIB.)

Case No.	Sex	Age	Position
1	Man	28	Left side *
2	Man	18	Left side *
3	Woman	32	Right side *
4	Man	31	Right side *
6	Woman	30	Left side ‡
8	Man	16	Right side *
10	Man	21	Left side (also apicolysis) †
11	Man	23	Right side (also apicolysis) *

B. MULTIPLE TUBERCULOSIS OF THE BODY. I. TOTAL THORACOPLASTIC PLEUROPNEUMOLYSIS.

Case No.	Sex	Age	Position
7	Man	17	Left side (also progredient intestinal tuberculosis and nephritis). Death, 5th day.
14	Man	34	Right side (also extensive suppurative costal tuberculosis) ‡
13	Man	19	Left side (also laryngotuberculosis, removal of the 1st rib). Death, 3d day.

II. PARTIAL PLEUROPNEUMOLYSIS; PARTIAL REMOVAL OF THE RIBS.

Case No.	Sex	Age	Position
5	Man	35	Left side, also right recent cavernous phthisis and larynx phthisis. Death, 4th day.
9	Man	47	Right side, also progredient suppurative costal tuberculosis. Death, 2nd day.
12	Man	40	Right side, and circumscribed cerebral tubercle.†

Certain recent cases have encouraged me to extend the procedure also to conditions of *slowly infiltrating non-cavernous phthisis*, since Case 8 showed, that the arrest of respiration is in itself capable of creating relatively favorable conditions for the cure of this type of phthisis also. These statements are made cautiously and guardedly, however.

* = Good, or best, recovery.
† = No better than before the operation.
‡ = State not so good as before the operation.

The direct mechanical effect upon the heart, through the collapse of the diseased lung, may constitute a serious feature of the operation, as I have shown in former publications. It does not manifest itself, however, in the presence of conditions such as those pointed out above, when the lung which is to be constricted is already very rich in connective tissue, and when the formation of pleural and mediastinal adhesions guarantees a certain stability of the topical relations in the interior of the thorax. I have furthermore succeeded in guarding against the danger of acute dislocation of the heart, by a simple device, namely, raising the arm of the affected side above the horizontal plane and still keeping the lung of the operated side somewhat in the balance, as it were, through the traction of the scapula and muscles, so that the effect upon the heart is allowed to manifest itself only gradually. The sum total of our experiences is that we have not lost a single patient through this cardiac disturbance.

In so far as the circulatory stasis in the blood and lymph currents of the lung on the operated side may mean a direct advantage for the local cure of the tuberculosis and for the restriction of its further spread, this must be left an open question for the time being.

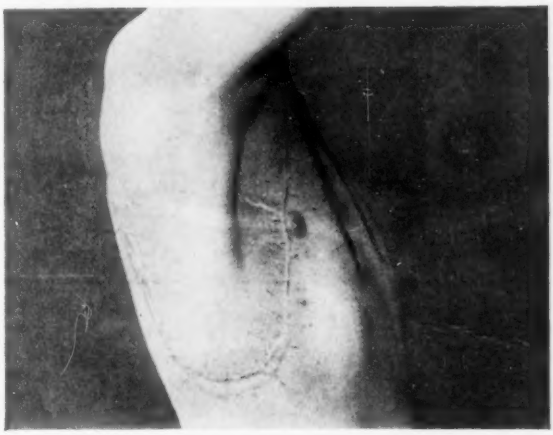
In four of our cases, a slight scoliosis of the vertebral column has developed, with the convexity towards the side of the operation (Fig. 3). The absence of the ribs as points of leverage for the shrinking, accounts for this form of the scoliosis. It is not marked enough in any case, not to be readily accepted by the patients in view of their otherwise improved condition.

The function of the serratus, elevation and other motions of the arm are very completely re-established after the operation, sometimes after having been impaired during several months. Only recently I had the opportunity of re-examining three male patients who had been operated upon on the right side, and had not sustained the slightest loss of strength in the right arm and right shoulder. I exhibit the pictures of one of these patients, with extensive right-sided cavernous phthisis,

FIG. 2.

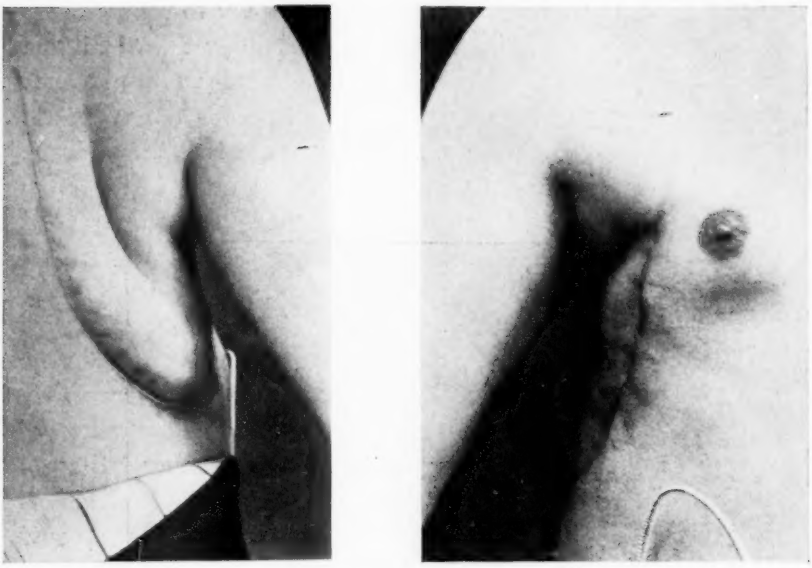
FIG. 3.

FIG. 4.



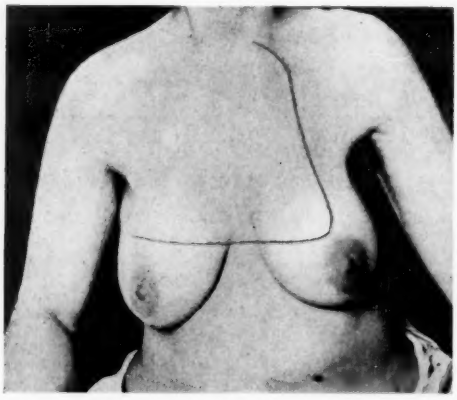
Phthisis, right lung. Total pleuropneumolysis. Best recovery
Dislocation of the sternum and vertebral column.

FIG. 5.



CASE IV.—Extensive cavernous right-sided phthisis. Total pleuropneumolysis. Two and a half months, and one year after.

FIG. 6.



CASE VI.—Diagram showing compensatory increase of volume developed in opposite lung.

photographed two and a half months and one year after the operation (Fig. 5).

The essential results of this treatment have already been published in German periodicals, and I am now in the fortunate position to state that we were again and again enabled to note a confirmation of our first experiences. The immediate results in the course of the disease are usually particularly impressive; *defervescence* follows rapidly, as a rule in patients with a high fever. The subsidence of the fever must be a result of the changed conditions of absorption, and accordingly permits a conclusion as to the favorable influence upon the latter, that becoming an *objective graduator* for the immediate effect of the operation.

In every case the amount of sputum is reduced enormously (from 200 to 10 cm. and less) within some days, at most weeks, after the operation, and the irritative cough diminishes. This would seem to justify the conclusion that it is the collapse of the cavities, after the relaxation of the lung tissue, and the cleansing of the cavity wall, which induces this result. This is the most impressive feature for the patient to begin with. Our past experience further shows, however, that not only the cavernous tissue is favorably influenced by *putting the lung at rest,* but so also to a considerable extent, is the as yet non-disintegrated, infiltrated portions. This is rendered intelligible in view of the encapsulation and cure of tuberculous foci, frequently observed elsewhere after the fixation of organs affected with tuberculosis. The potential conditions for curability are certainly more favorable in the lungs than in most other organs with the tuberculous affections of which we are concerned. Our verdict in this respect must necessarily be guarded, in view of the lack of post-mortem evidence. Should this observation be further confirmed, it would materially extend the indications for our intervention.

In all our cases, an increase of the body weight and improved subjective condition are noted in the further course. It remains of the greatest importance to see to it that in the selection of the cases for the operation, the patient has not yet

passed his fortieth year, that the general nutrition either is fairly good or is rendered as favorable as may be prior to the performance of the operation, by means of climatic treatment, rest in bed, and dietetic measures. It is also necessary to ascertain that aside from the diseased lung of one side, there are *no recent* tuberculous manifestations in other organs. I should certainly be extremely cautious in the admission of such cases, and have only had reason for regret whenever I have allowed myself to be persuaded to operate on the request of patients who had been dazzled by our results in other cases. Three such patients, with multiple tuberculosis (also of the larynx, bones or bowel), died in immediate connection with the operation.

Concerning the extent of the affection on the diseased side, however, we have no restriction to offer at present, simply repeating that the more complete a restriction in volume can be obtained, the more complete will be its beneficial effect. Our cases without exception concerned very far advanced consumptives, in all of whom the prognosis of persistent aggravation had been rendered by highly competent physicians. Hence, he who interferes with a grave condition such as this by means of such a radical operation, will keep in mind that the measure of success cannot be guaranteed, and is necessarily relative only. But even if surgical interference improves the situation in so far only as to lengthen the lives of a certain percentage of otherwise doomed consumptives, giving them a sensation of returning health, and introducing more or less positive objective amelioration of the general condition and the local lesion, this means a step in advance which physicians and patients will hardly fail to appreciate.

RESECTION OF RIBS, COMBINED WITH EXTERNAL PRESSURE, IN THE TREATMENT OF TUBERCULOSIS OF THE APEX OF THE LUNG.*

BY LEONARD FREEMAN, M.D.,

OF DENVER, COLO.,

Professor of Surgery in Denver and Gross Colleges of Medicine.

ALTHOUGH so much has been done towards the successful management of pulmonary tuberculosis, through climate and hygiene, the possibilities of surgery should not be lost sight of, especially in cases which resist ordinary methods of treatment. Enthusiasm in this direction, however, should be tempered with reason and caution, bearing in mind that many obstinate cases recover spontaneously. No operation should therefore be considered that does not offer at least a fair likelihood of substantial improvement, without too much danger, and without too great a prospect of leaving the patient worse than before, although it must be admitted that desperate measures may occasionally be advisable in desperate cases. From this point of view, such operations as pneumonectomy, pneumonotomy, and Friedrich's " costoplastic pneumolysis " should be approached with caution.

One of the most potent factors in the cure of pulmonary tuberculosis, with or without the presence of cavities, is the gradual formation and contraction of fibrous tissue, which seems to be promoted by collapse of the lung and freedom from motion. Hence any procedure favoring pulmonary retraction, as a whole or in part, should be of service. A spontaneous tendency in this direction exists in the subclavicular flatness, intercostal hollowing, and drooping of the shoulders, so often observed in consumptives; and it is suggestive that athletic individuals with well developed and powerful thoraces often exhibit the most rapid and hopeless forms of phthisis.

* Read before the American Surgical Association, June 3, 1909.

Pulmonary collapse may be obtained, to a greater or less extent, in several ways: (1) By the production of an artificial pneumothorax (Murphy, Forlanini). (2) By extrapleural resection of nearly all of the ribs below the first, from their cartilages to the spine, and including their periosteum (Friedrich). (3) By the removal of portions of some of the ribs, with their periosteum, along the axillary line (Quincke, Spengler, Turban, Landerer, Garré, etc.). (4) By the resection of portions of several ribs and their periosteum directly over the diseased part of the lung, usually a cavity near the apex. (5) By a similar operation, without the removal of the periosteum, followed by external pressure by means of a truss, this being the procedure to which I desire to call attention in this paper.

The Murphy-Forlanini method is quite free from danger and is of undoubted value when the lung is free; but when adhesions are present its feasibility and usefulness are correspondingly lessened. In disease of the apex, especially if advanced and with a tendency to the formation of cavities, the procedure is restricted in its usefulness, because of adhesions which prevent collapse and cause continuous movements in unison with those of the thoracic wall. This does not necessarily mean, however, that nothing is gained, because tuberculosis of other portions of the lung may be benefited; but it does mean that the chest-wall directly over the diseased apex must be mobilized if the best results are to be obtained.

Friedrich's costoplastic pneumolysis is an extensive operation and by no means free from danger, especially in the advanced cases where it is most strongly indicated, requiring, as it does, the complete removal of nearly all the ribs, together with their periosteum. The technic is difficult, because the delicate pleura must not be torn; and the work must be rapidly done owing to the weakened condition and defective circulation and respiration of the patient. Manifestly the method is only justifiable in extensive lesions, where adhesions exclude the production of an artificial pneumothorax, and where all ordinary treatment has failed.

The removal of portions of ribs and their periosteum along the axillary line varies in danger and difficulty according to the extent of the operation. Its effectiveness will depend largely on the nature and situation of the adhesions and the areas of lung involved. An adherent apex, for instance, could not be greatly influenced by the removal of a few ribs along the side of the chest.

A limited resection, however, of two or three ribs near the apex can be done with perfect safety, under local anæsthesia if desirable, and may be of much service, especially if supple-

FIG. 1.

Truss for external pressure on wall of thorax after resection.

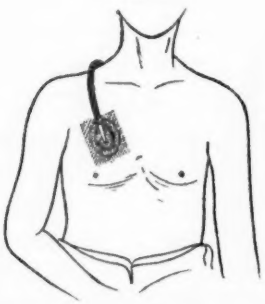
mented by external pressure in the manner to be described. The chest wall can in this way be caved in directly over the seat of the disease, where most needed, thus favoring shrinkage of cavities and healing by fibrous contraction. In spite of contrary statements I am convinced that much good cannot be obtained in such cases by costal resection elsewhere, or by the production of an artificial pneumothorax, owing to the resistance to collapse presented by the thickened lung tissue reinforced by a rigid, adherent thorax.

This procedure should not be applied indiscriminately, but should be reserved for refractory cases with marked and limited apical lesions, especially when a tendency to the formation of cavities exists. It should also be of service as an adjunct to an artificial pneumothorax, when there is reason to believe that the trouble in the apex is of such a character that it will

be but little influenced by collapse of the remainder of the lung.

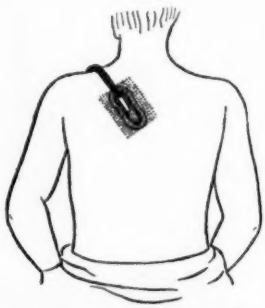
In this operation two or three inches are removed from the second, third, and possibly fourth ribs, below the clavicle; and if it seems to be desirable, the cartilage of the first rib may also be divided in the manner suggested by Freund. This much has been done now and then with varying results for many years, for instance by Macewen, of Glasgow. Occasionally the periosteum was removed, and often it was allowed to remain, but as far as I have been able to ascertain, external pressure was never employed.

FIG. 2.



Thoracic truss applied, anterior view.

FIG. 3.



Truss applied, posterior view.

When the periosteum is *not* removed the ribs usually reform quite rapidly; hence, seeing that retraction and healing are slow processes extending over months at least, the utility of the operation is necessarily limited unless collapse is hastened by external pressure. Even when the periosteum *is* removed, at the expense of increased operative risk, the thickened and sometimes almost cartilaginous pleura must retard the cure.

It occurred to me some years ago that collapse of the thoracic wall might be materially hastened and increased by the application of external pressure by means of a truss. In order to accomplish this the second and third ribs are resected through a flap-incision, and after the wound has healed and lost its sensitiveness, a bunch of gauze is placed over the part

and an ordinary spring-truss adjusted so as to make considerable pressure, the pad of the truss resting in front and the spring passing over the shoulder to the back, where it obtains its counter-pressure. An ordinary truss with a good spring and an adjustable pad will answer the purpose, although it may be advisable to shorten the spring and add a large flat pad to fit the back. The pressure can be increased to the point of tolerance, either by increasing the thickness of the gauze pad or by altering the curve of the spring. The apparatus need not be uncomfortable when properly adjusted.

It is surprising how quickly and decidedly the chest wall can be caved in by this simple and safe procedure, leaving a saucer-like cavity, in spite of the fact that the periosteum of the ribs has not been removed; in fact the preservation of the periosteum may be of some service, in that the re-formation of bone may help to retain the full depth of the depression. Another service which the truss renders is to assist, by its constant firm pressure, in the local immobilization of the thorax, thus placing the lung more nearly at rest.

Recovery from a tuberculous lesion is necessarily slow, especially if a cavity is present, and may be protracted over many months, even under the most favorable conditions; hence marked improvement should not be looked for too soon. And it must also be understood that an operation is but a factor in the cure and perhaps not even the most important one.

I have employed this operation in but two instances, but in both the results were encouraging. The case-histories are briefly as follows:

CASE I.—A young man of nineteen, an inmate of The Denver National Jewish Hospital for Consumptives, who had been afflicted with hemorrhagic phthisis for about four years. Quite a large cavity existed in the left lung just below the clavicle, from which several ounces of yellowish, nummular sputum were expectorated daily. He was weakened and emaciated and there was no tendency towards improvement. Portions of the second and third ribs were removed, truss-pressure applied, and a marked depression rapidly produced. Decided improvement was

noticed in about five months. At the end of twelve months the nummular sputum had practically disappeared and has not returned up to the present time—about eight years. The general health has also undergone marked improvement, although he is still tuberculous. It is worthy to note that some months previous to the above intervention a spontaneous pneumothorax had occurred, followed by an empyema, for which an extensive Estlander operation was done. Although perhaps two-thirds of the lung had thus been collapsed, no curative effect upon the cavity resulted until the chest was caved in at the apex.

CASE II.—A man of 45, who had had phthisis for twenty-five years (patient of Dr. Alfred Mann, of Denver). A large cavity existed at the right apex, reaching down to the third rib, from which a characteristic expectoration of several ounces took place during the twenty-four hours. About three inches of the second and third ribs were removed and truss-pressure applied, which caused a rapid sinking in of the chest wall. In about five months a decided improvement had taken place, the nummular sputum being reduced to a small quantity. There has been no re-formation of the cavity at the end of 7 years and the general condition of the patient remains much improved, although there are still evidences of the presence of moderate pulmonary tuberculosis.

Conclusions.—1. The healing of stubborn tuberculous pulmonary lesions is favored by collapse of the lung.

2. This may be obtained by (*a*) artificial pneumothorax; (*b*) extensive extrapleural resections of all of the ribs, with removal of their periosteum; (*c*) local resections of ribs, especially at the apex.

3. The first method is not always applicable, owing to adhesions and to induration of lung tissue, while the second is difficult and dangerous, and should be employed under exceptional conditions only.

4. The third method is applicable to obstinate troubles at the apex, and can be employed alone or in conjunction with an artificial pneumothorax, according to circumstances. Its full benefit cannot be obtained, however, unless the removal of the ribs, which need not include their periosteum, is followed by the application of firm external pressure in the manner suggested by the writer.

THE TREATMENT OF FISTULÆ AND ABSCESSES FOLLOWING OPERATIONS FOR EMPYEMA OF THE THORAX.*

BY ALBERT J. OCHSNER, M.D.,

OF CHICAGO,

Surgeon-in-Chief of Augustana and Saint Mary's Hospitals.

ALTHOUGH the relative proportion of persistent fistulæ and abscesses is not so great as formerly after operations for the relief of empyema of the chest, since surgeons take the same precautions as in aseptic cases to prevent secondary infection during and after this operation, they are still sufficiently common to be a source of much annoyance to the surgeon.

There are, of course, other elements of value from the standpoint of prophylaxis, aside from that of aseptic operation and after-treatment.

The method advised by Murphy of aspiration and subsequent injection into the pleural cavity of 60 c.c. of a 2 per cent. solution of formalin in glycerine and the plan of making tubular through drainage in case of operation instead of simply making drainage into the pleural cavity, should be mentioned especially. The former method of treatment makes the latter unnecessary in many cases, and the latter method reduces the number of persistent fistulæ and abscesses to a minimum, because it eliminates the formation of pockets.

In cases in which these sinuses or abscesses persist, however, in which formerly the method of Estlander and Schede gave the most reasonable promise of ultimate success, surgical treatment has often been most disappointing. It is just in this class of cases that the method introduced by Dr. Emil Beck has given the most satisfactory results.

The method consists in filling the sinus or pus cavity with one or two solutions of bismuth subnitrate and keeping this

* Read before the American Surgical Association, Philadelphia, June 5, 1909.

in position by plugging the outer opening with gauze. Solution No. 1 consists of one part of arsenic-free subnitrate of bismuth and two parts of sterile amber vaseline; solution No. 2 contains 30 parts of bismuth, 60 parts of amber vaseline, and ten parts of paraffine of sufficient hardness to give the mass a fair degree of firmness at the body temperature.

No. 1 is injected every second day until suppuration has almost disappeared, then No. 2 is injected in its place. The injections are repeated as often as necessary to keep the sinus or pus cavity constantly filled with the mixture. At first it is necessary to do this every day or every second day, then every third and so on until it may be necessary to inject not oftener than once a week or ten days.

The Table on pages 154, 155 and 156 gives a list of fourteen cases in which we have employed this form of treatment, and it shows results which are much better than those we were able to obtain previously.

One feature has been most striking. In cases which were in a septic condition when the treatment was commenced, the improvement of the general condition of the patient was especially marked. Pulse and temperature became normal within a few days and the general appearance of the patient lost the characteristics of sepsis. The nutrition improved and the anæmia disappeared rapidly. The discharge from the sinuses usually becomes sterile in a short time.

To illustrate this a short abstract of the history of Case V will be typical.

A. S., an Italian laborer, 60 years of age, had a pneumonia followed by empyema of the right thorax, seven months ago. The pleural cavity was drained; a sinus persisted, leading into a large cavity. Three months later Estlander's operation was performed with excision of three ribs. The patient was in a severely septic and anæmic condition when he entered the hospital October 5, 1908. An injection of 720 c.c. of mixture No. 1 was given and the patient put to bed. In two days 60 c.c. more was injected, but by this time the septic condition had markedly decreased, and within a week the patient became normal and

his anæmia began to disappear. For one month injections were made every second day, the quantity in the meantime decreasing to 35 c.c. and the patient acquired a rosy appearance. Then he was sent home,—at first, to return twice a week to have a few c.c. of No. 2 injected, and later only once a week, a sufficient amount being used each time to fill but not to distend the cavity.

At present, June 1, his general health is perfect and there is but a superficial sinus which holds scarcely 5 c.c. of the paste, and which will undoubtedly heal completely in a short time.

A second case, No. 3, seems worthy of special description because it is one of the cases that were formerly extremely difficult to heal.

History in Abstract.—F. C., American, age 35, miner, had a severe fall nine months ago while working in the mountains; this was followed by pneumonia and then by a right sided empyema. This was drained through a rib resection opening. Seven months later an Estlander operation was made, with resection of three ribs. At the end of two months the patient came under our care—November 24, 1907. At this time there was a sinus discharging pus freely, and the patient coughed up the same material. This was before we were familiar with the bismuth paste treatment—so we performed Schade's operation. The patient did well for nearly a week, when he developd a phlebitis in both femoral veins. He became markedly septic and emaciated. Four weeks later he still expectorated pus, and there was a free drainage of pus from the wound when we began the injection of No. 1 bismuth paste. He expectorated much of the 650 c.c. of the paste we injected. We repeated the injection, each time simply filling the cavity without using any force. The pus and the sepsis subsided rapidly. In ten days he appeared like a different person, and in twelve weeks he was perfectly well.

I have used this method in fourteen cases at the Augustana Hospital in the treatment of sinuses or abscesses which have persisted after operation for the relief of empyema of the chest. Three of these cases had been operated twice and one three times before this method was employed, without obtaining a cure. Of the fourteen cases all but two, which are still

SYNOPSIS OF CASES OF THORACIC FISTULÆ TREATED BY BISMUTH PASTE INJECTIONS

Number	Hospital number	Sex	Age	Admitted	Discharged	Date of primary operation	Date of second operation	Injection of bismuth paste	History	Result
1	19986	F	11	Dec. 27, 06	June 27, 07	Dec. 29, 06	.....	Had 12 injections of paste every 3rd day 1 to 3 ounces beginning Jan. 21, 1908	At time of operation, Dec. 29, 1906, 500 c.c. of pus evacuated. Empyema followed attack of measles. Through and through drain was placed. Sinus persisted two years when injections were used	Sinus closed completely after 12 injections.
2	21933	F	69	Oct. 10, 07	Feb. 17, 08	Oct. 12, 07	.....	Injected with paste every 3–4 days from March 19, 1908 to February 22, 1909. 1–4 ounces	Empyema followed attack of pleurisy of 3 months duration. Three ribs resected but sinus persisted and patient returned 1 year later for injections	After 24 injections practically closed and patient returned home.
3	22220	M	25	Nov. 24, 07	Mar. 29, 07	Mar. 14, 07	Oct. 4, 07 Nov. 24, 07	Injections began December 20, 1907. First injection 20 ounces; second injection 12 ounces. After this varied from 2 to 8 ounces	Empyema followed pneumonia. Resected portion of 3 ribs. 7 months later had profuse discharge of pus and 6 weeks later greater portion of 6th, 7th, 8th and 9th ribs were removed. Patient still remained septic	Patient showed marked improvement after first injection, making rapid recovery. At end of 3 months wound perfectly healed; 38 injections given.
4	23120	F	16	Apr. 15, 08	June 13, 08	Apr. 16, 08	.....	Injections began June 25, ended August 8; amount from 1 to 4 ounces; intervals 2 to 6 days	Empyema of chest following la grippe. Portion of 8th rib resected and about 30 ounces pus evacuated. Through and through rubber drains. Patient left hospital June 13, 1908; drainage remained rather profuse. On June 25 returned to hospital for bismuth treatment	Patient gained rapidly from time of first injection, and August 10, 1908 wound was completely healed. About 15 injections were given.

5	24315	M	60	Oct. 5, 08	Oct. 22, 08	Mar., 08	July, 08	Injections began October 5, 1908. 12 ounces injected daily for 5 days. After this 1 to 3 ounces every 4th or 5th day	Empyema of chest following pneumonia. Both operations done elsewhere. On admission to hospital 4 months after second operation, had profuse discharge of pus from chest	Made satisfactory progress. At end of 6 weeks was practically no discharge of pus. Sinus almost closed. Holds only 5 c.c.
6	24497	M	28	Oct. 28, 08	Mar. 4, 09	Oct. 29, 08	.....	Injections began November 10, 1908. Quantity 2 to 12 ounces, interval 2 to 6 days	Empyema of right chest, following stab wound on September 20, 1908. On admission patient was in a septic and greatly emaciated condition. Portion of rib (6th) resected and drainage established	Patient gained rapidly after beginning of injections. Is back to normal weight. Sinus not completely closed June 1, 1909.
7	24674	M	18	Nov. 23, 08	Feb. 10, 09	June 28, 09	Nov. 24, 08	Injections from December 12, 1908, to February 10, 1909. 1 to 2 ounces every second or third day	Empyema following pneumonia. Rib resected June, 1907. Profuse discharge of pus until admission November 24, 1908. 3 ribs resected and through and through drainage placed	Patient made satisfactory recovery and sinus was closed at time of discharge from hospital, after 25 injections.
8	24694	F	20	Nov. 25, 08	Dec. 27, 08	Nov. 25, 08	.....	Injections began December 25, 1908 and continued to February 4, 1909, at intervals from 2 to 6 days. Amount, 1 to 4 ounces	Empyema following pneumonia. Resection of 7th rib on right side and large amount of pus evacuated. Through and through drainage placed	Patient made very satisfactory progress, with complete recovery at end of 12 weeks.
9	24717	M	41	Nov. 29, 08	Dec. 24, 08	Nov. 29, 08	.. ..	Injections 1 to 2 ounces every second day from December 5, 1908, to December 23, 1908	Empyema of right chest. Right 9th rib was resected and 25 c.c. pus evacuated. Colon bacillus and streptococcus	Patient gained rapidly and left hospital 25 days after operation. Sinus in chest still open. Has healed entirely June 1, 1909.
10	25024	M	18	Jan. 19, 09	Mar. 19, 09	Jan. 20, 09	.....	Injection from February 19 till March 19, 1909, at intervals from 1 to 3 days	Empyema following pneumonia. Resected part of 7th rib, left side. Evacuated about 40 ounces of pus. Drainage placed	Made very rapid recovery. Small sinus present at time of discharge from hospital, but no discharge of pus. Entirely healed June 1, 1909.

SYNOPSIS OF CASES OF THORACIC FISTULÆ TREATED BY BISMUTH PASTE INJECTIONS—*Continued*

Number	Hospital number	Sex	Age	Admitted	Discharged	Date of primary operation	Date of second operation	Injection of bismuth paste	History	Result
11	25117	F	8	Feb. 1, 09	Apr. 5, 09	Feb. 3, 09	.....	Injections began February 20, 1909, at intervals 1 to 3 days. Amount 1 to 3 ounces	Empyema following pneumonia. Resection of 4th and 5th rib. Evacuated 12 ounces of pus. Drainage placed	Complete recovery at end of 9 weeks.
12	25195	M	45	Feb. 12, 09	Still in hospital	May 19, 08	Feb. 15, 09 Apr. 2, 09	Injections begun February 20, 1909. Continued at intervals 1 to 3 days since	Tuberculosis of 4th rib. May, 1908, a sinus was curetted. February 15, 1909, excision of 4th and 5th ribs. Tuberculous. April 2, 1909, 4th, 5th, 6th, 7th and 8th ribs left side were resected and about 16 ounces of pus found in pleural cavity. Cavity drained and later injected with bismuth paste	Patient greatly improved; still in hospital. Present discharge slight.
13	25212	F	4	Feb. 16, 09	Apr. 7, 09	Feb. 18, 09	.....	Injections began March 1, 1909. 2 to 4 ounces every day for 4 weeks	Empyema following pneumonia. Resection of right 7th rib and evacuation of 12 ounces of pus	Complete recovery at end of six weeks.
14	25816	M	24	May 10, 09	Still in hospital	July, 05	Aug., 05 June, 07	Injections began on admission. 6 to 8 ounces injected 3 times a week since	Empyema following pneumonia. In July, 1904, after 3 operations, sinus still persists with profuse discharge of pus. At last operation 4 ribs were resected	Patient gaining in weight. Pus discharge greatly diminished.

under treatment, have been cured, and these two are making satisfactory progress.

This treatment has proven most satisfactory in our practice. We have used it only in cases with sinuses, although it has been suggested to aspirate the pus in empyema and to inject the paste into the pleural cavity through the trocar.

There has been no case of bismuth poisoning in our series of cases, although this might easily occur—as it has when cavities in other portions of the body have been filled with large quantities of bismuth paste. If this occurs, Beck advises the immediate injection of hot olive oil, 110° F., which will dissolve the paste and facilitate its escape through the outer fistula or through a drainage tube, which may be inserted.

The injection is made with a large, ordinary glass syringe, just enough force being employed to fill the sinus or cavity, but not enough to cause forcible distention. The outer opening is carefully plugged with sterile gauze.

EMPYEMA THORACIS.*

BY ALBERT VANDER VEER, M.D.,

OF ALBANY, NEW YORK,

Professor of Surgery in the Albany Medical College.

IT is safe to assert there are few lesions where the physician and surgeon are called upon to assist each other in diagnosis and treatment, more interesting, and, at times, more difficult, than effusions within the pleura. Plastic pleurisy may have its surgical complications, but it is largely a medical condition, and one wherein the surgeon is not so much concerned. The serous effusions, however, present an entirely different history and line of procedure. Few conditions give so entertaining a solution of questions that, seemingly, forty-five years ago, were so hidden and mysterious, studied at that period, and even for two decades later, with the firm belief that surgical intervention was too dangerous to undertake. As one recalls these early impressions one cannot but feel encouraged over the fact that in this line of investigation operative surgery has made advances commensurate with the pathology and technic of other important branches of our art. It is not my province to discuss why a serous effusion in one case—where one-fourth, one-half or even more of one side of the chest may be involved—may continue for months, or even years, without any evidence of pus being present, and yet another case with the same clinical history may in a few weeks or months terminate in pus and present the condition we term empyema.

The only argument I have to offer in presenting this paper is my personal, practical experience. The point I wish to bring out is the change, in my time and in the memory of many members of our profession here to-day, in the surgical treatment of these cases. The willingness with which the general practitioner encourages the surgeon to approach these cases to-day, compared with four, three or even two decades

* Read before the American Surgical Association, June 4, 1909.

ago, is comparable only to the advance that has been made in the treatment of lesions of the appendix, the gall-bladder and other organs within the abdomen; yet it cannot be said that this change is entirely due to the aseptic surgery that has permitted us to invade the peritoneal cavity so boldly, for the technic of the two operations is very different. My early recollection of surgery of the chest presents a strong contrast with what we are now doing so fearlessly. Then, when once it was determined to evacuate fluid from the pleural sac (almost invariably pus) what precautions were demanded! We had had it impressed upon us by such splendid men as Trousseau and others, as early as 1846, and again in 1864, that the operation for paracentesis was an exceedingly grave one, and should be had recourse to only "when there is danger to life from immediate suffocation, or when the effusion is very large." Marrote, writing at the same time, gives a clear distinction between serofibrinous and purulent effusions and states, "that the radical operation of incision is the only one in purulent effusions that is at all likely to lead to a cure," and he was right, yet how very slow were our surgeons in following this advice. How well do I call to mind the discussions in our societies on up to 1880, as to the manner of treating effusions within the chest, in reference to evacuation and the entrance of air. In my early years of practice I had read Bowditch's discussion of the subject, presented as early as 1852, in which he advocated aspiration, and its application to all thoracic effusions; later another paper, published by him in the *American Journal of the Medical Sciences*, in 1864, in which he denies "that any ill results are likely to follow, or that purulent effusions cannot be effectually withdrawn through the capillary tubes provided for that operation." These were convincing contributions, yet how many suggestions were made at this time controverting his views! One very ingenious method was that of fastening about the cannula a portion of rubber tubing, or rubber dam, in such a manner that a trocar could be introduced and withdrawn under water, and the operation performed in such a way as to

exclude the entrance of air into the chest cavity. This was a method that was advocated with a good deal of earnestness. My study of Bowditch's papers, and the experience I had had during the Civil War, led me to believe that these cases required free drainage, and that this fear on the part of the physician, and his unwillingness to yield to the advances of the surgeon's experience, would pass away; yet how slow was the progress. The method of simple aspiration carried with it such a high mortality that aseptic surgery was hailed as a factor of great assistance, and incision was encouraged, but only with the employment of the strong carbolized spray. I have often seen this used, and compelled myself to make use of it, because of the pressure brought to bear by the attending physician, who wanted Listerism carried out to the utmost, and yet how clearly would nature demonstrate her ability to take care of the chest cavity if only a free opening were provided! In 1864, Dr. Howard, of the United States Army, was permitted to go to the front to treat gunshot wounds of the lung by immediately sealing the wounds of entrance and exit with collodion, then applying firm compresses over the chest, the object being to exclude the air. I had an opportunity of witnessing this procedure in several cases, and in every instance if the effusion of blood did not force the dressing the accumulation of pus would be such that the dressings would become saturated and nature would assert her desire for free drainage. At that time I considered thoughtfully the *few* remarkable cases, such as that of General Shields during the Mexican, and others, in which it was said a silk handkerchief was passed through from one opening to the other, recovery following, and it seemed to me that Dr. Howard's method would soon be counted a failure, which it was within a very short period. However, I did not make use of my impressions afterward, in civil practice, for the opinion of the general practitioner with whom I came in contact was opposed to any such procedure as a free opening into the chest, but Dr. Bowditch's views were gaining ground and were bound to prevail.

Among the number of gunshot wounds of the chest and perforation of the lung treated successfully by myself during the Civil War, the following is most typical:

Lieut. A. N., 66th N. Y. Vols., æt. 21 years, July 21, 1865, while with his company, in trying to control a riot, was struck by a Minie ball, which entered the cavity of the thorax between the sternal end of the left clavicle and the second rib, without fracturing either. The wound was received while advancing towards the person firing, who was not more than fifteen feet distant. This bullet passed directly through the apex of the lung, making its exit just above the spine of the scapula, fracturing the latter bone severely. He was wounded at six P.M. and I saw him about a half hour later. The patient was bleeding very freely, expectorating blood, respiration extremely difficult, pulse rapid and hard to count; pupils largely dilated; suffering much pain. I immediately gave him ¼ gr. of morphine, continuing the same as needed, at the same time giving as much brandy as he could swallow—in all about six ounces during the night. Ice compresses were placed to anterior wound, and hard linen ones to posterior exit of ball. Two minims of tincture of aconite were given every two hours next day, with small pieces of ice in mouth to allay thirst; patient kept absolutely quiet on back; apparently little hemorrhage, and no blood expectorated; no color in face or lips; very anxious expression; passed urine in small quantities and infrequently. More comfortable during second night, but somewhat delirious. Pulse 120–130, short and quick, feeling the effects of stimulus; catheter necessary to relieve bladder of a large quantity of urine; no desire to move bowels; very restless third night, starting suddenly and saying he would die if something was not done for his relief. Under assuring words and medicine he quieted down. Complained of bed feeling hot; changed same, but not his shirt in which he was wounded. He had bled sufficiently to saturate two thick hair mattresses, and blood was beginning to drop to the floor. Fifth day expression improved somewhat, and pulse, under aconite, reduced to about 100; respiration easier. Air passed in and out through both wounds when compresses were removed. Evidently a large branch bronchial tube had been injured. Same general treatment continued until June 28, eighth day, when aconite was dis-

continued. Bowels moved and patient passed urine freely in normal manner; appetite good; partook freely of beef tea, soft cooked eggs, etc. Patient had been a prisoner for several months in rebel prison in 1864–1865, and we feared a return of the chronic diarrhœa he then suffered from. Free discharge commenced at this time, June 28, from both wounds, at first clotted blood, then pus. Wound was kept clean by frequent washing with soap and warm water and a saturated solution of chlorinate of soda, also the use of a silver drainage tube posteriorly. July 12, general condition much improved; no secondary hemorrhages; treatment continued about the same; very small amount of stimulant given. Anterior wound healed; pus still discharging from posterior wound; there seemed no way of measuring the quantity, yet it saturated a large pad and the back of his woollen shirt twice in twenty-four hours. Morphine in divided doses during the night to make him rest easily; tincture of iron continued, and some color in lips, but not much in face and his hands were pearly white. July 15, in A.M. had a decided chill, not very free perspiration following; entire loss of appetite with some looseness of bowels; reason to fear pyæmia; gave free doses of quinine and stimulants. Chill did not return and in a few days he felt better.

July 28, I removed several portions of the necrosed scapula; respiration good in lower lobe of left lung; lack of it, with entire dulness, on percussion of upper lobe. Discharge from posterior wound enormous.

August 3, patient can now sit up in bed and is able to be moved to his home in Westchester. The journey did not seem to exhaust him a great deal. He did well for about a week when a severe attack of dysentery came on and reduced him rapidly. This yielded to treatment, and without further hindrance he continued to improve, and in a month was able to leave his bed. The discharge of pus continued quite freely for a time but gradually ceased, and on October 15 the posterior wound had healed entirely. Marked depression under left clavicle and some drooping of left shoulder; auscultation and percussion showed little use of upper lobe of left lung. He began a gradual course of exercise, continued his good diet and improved very rapidly.

July 4, 1866, I was surprised to see what a complete recovery he had made. He had entire use of the lung, except a small portion of the apex, apparently just above the track of the ball.

There are some points of particular interest in this case:

1. As to the great amount of blood lost, and the probable result had the wounds been closed in accordance with Dr. Howard's method, and the blood allowed, or forced, to remain in the cavity of the thorax.

2. The enormous quantity of pus discharged and in spite of this the ability of the patient to keep up.

3. The entire recovery of lung after it had been so long out of use, or in a state of collapse. In this case there was marked empyema. We attempted relief from this condition by using a silver tube and keeping the wound in a dependent position, which I think was most beneficial.

In January, 1909, I had an opportunty of examining this wound, at Los Angeles, Cal. The Major had been living in southern California for two winters, the climate appealing to him as affording more comfort than that of New York. Scarcely a scar could be seen at the point of entrance and exit. He had perfect use of his arms, and Dr. Poddinger, who was so kind as to examine him, assured me the lung was quite normal in its function.

This case in my earlier years gave me much comfort in the treatment of cases of empyema, traumatic or otherwise.

As late as 1878, Powell, who was one of the best authorities at that time, in writing upon the subject of empyema said: "As it is clear that we cannot empty the pleura even in recent cases without admitting air in place of fluid, we must adopt one of three methods: (1) Either to disinfect the air admitted into the pleura, and having inserted a cannula, to close the wound with antiseptic dressings to be renewed with the same precautions every three or four days; or, (2) to make a double opening and introduce a drainage tube, so as to permit the escape of pus as rapidly as formed; or, (3) to make a single incision or free opening and insert a tube through which the pleura can be daily washed out with some disinfecting fluid." Of these three methods he says the first is to be preferred. At this period, or about 1880, and for the next five years, the discussion that older physicians gave the treat-

ment of empyæma, either by tapping or drainage, and finally, much later, by resection of the ribs, was most strenuous. My own experience with individual and older physicians was most emphatic. Occasional reports of a single case, by earnest operators, such as Martindale, of Port Richmond, presented in the *American Journal of the Medical Sciences,* July, 1881, were well worth studying, and illustrated the good effect of through and through drainage. In the *Medical News,* May 7, 1887, Dr. Strickler of Colorado Springs presents a most interesting paper on resection of the ribs and the treatment of empyema, but at this late period the old theories were in his mind, for here he states, "that no disturbance was caused by the admission of air into the chest cavity."

In my own mind, the decade from 1880 to 1890 presented a period of time when I had worked out the treatment of pleuritic effusion, and it has been my guide since. Antiseptic surgery, by means of the carbolized spray and aspirator, was not practicable in the treatment of such cases, and this became my formula: In a diagnosis of pleuritic effusion, when the temperature and pulse indicated that the fluid was yet sterile serum, I have insisted upon a very thorough effort at medical treatment being made, such as the use of a thoroughly dry diet, local application of blisters, free evacuation of the bowels, outdoor exposure, and plenty of sleep, and I have seen many happy results, both in children and adults, the latter more particularly. When there is a rise in temperature, increase in the pulse rate, perhaps a chill, and later a marked leucocytosis, and the suspicion arises that pus may be present, I have always insisted upon a free evacuation, but I have had strange experiences occasionally. The evacuation of pus by means of the trocar would result in the recovery of the patient, and this case was held up as an illustration by many conservative physicians in the neighborhood as one in which even drainage by means of the rubber tube was not necessary. Any excuse was offered for non-operative intervention. This, however, was finally the ground of compromise: That if the trocar and the drainage tube did not bring about a good result within

a reasonable time, I was not willing to yield any further to the conservatism of the good and respected family physician. If, however, the fluid remains sterile I believe a small percentage of these cases will recover by judicious, repeated use of the aspirator, but when once pus is discovered the use of the trocar and introduction of the rubber drainage tube is admissible, having the opening as low down as possible, and keeping the tube within the pus cavity. This treatment in cases under twenty-one years of age gives a very large percentage of recoveries. Failing, however, at this time in life, and particularly after the age of twenty-five, in this line of treatment, then resection of one, two, three, or four ribs, two to five inches, becomes necessary.

I have a record of a number of cases of pleurisy associated with malignant conditions not only of the lung but of growths elsewhere, in which the patient suffered from the associated attacks of pleurisy, and where I have seen marked relief from simple aspiration, going no further in other cases than to introduce the rubber drainage tube.

Cases of double empyema have, in my practice, been very rare. Much has been said regarding the danger of syncope and death, in the evacuation of pus, in all cases, either double or single, but the only fatal case I have encountered was that of a boy four years of age, who was suffering from double empyema, who had little breathing space left, and was very nervous and frightened at the thought of having anything done. Local anæsthesia was attempted, but his struggles were so great we were finally forced to give him a general anæsthetic, and just as I was puncturing the right chest the little fellow collapsed and expired. It has been my custom to evacuate the chest with great care, always insisting upon the horizontal position of the patient, and I have seldom seen a case of syncope. This case was a sad one in many ways and not infrequently quoted by friends when a similar line of procedure was suggested.

The use of the rubber drainage tube as the sole dependence in the treatment of cases of empyema, especially in adults,

cannot be considered as a successful method. In children it is likely to produce more serious deformity, and adults, if they do not recover at once, undergo a prolonged illness. Unless the patient's surroundings are especially good, and the previous family history above all possible suspicion, I have noticed that tuberculosis, in many instances, presents as the final condition.

It is interesting to note how the cavity of the pleura is disturbed and the distressing cough and irritable conditions that present when the loss of the drainage tube takes place. I have been called to see these cases and have noticed the great disturbances that presented in a train of symptoms having a most depressing, unpleasant effect upon the patient and friends, but I have not yet met with a case in which a foreign substance eluded resection, an accident that ought not to occur.

That empyema has claimed many methods and a great variety of operations for its relief cannot be denied, but like many surgical questions the solution has been delayed through the tenacity with which the family physician would, in former days, adhere to milder surgical procedures; this, however, is finally passing away. Their views were greatly to be respected and their arguments for a conservative line of treatment of these cases met with some success, but I am convinced, and feel able to assert that there can be no longer any doubt that the sooner a case of empyema is relieved (that in a number of cases resection of the rib is really necessary), and that this line of treatment must prevail to a greater degree in the future than in the past.

In the washing out of the cavity, after resection, and when employing simple drainage by means of the rubber drainage tube, I have had my attention called to the unpleasant effect of the use of peroxide of hydrogen. This is to be expected, and long since I have counselled against this antiseptic, employing much milder preparations which do not give the patient so much distress.

I have observed with much interest the cases that have

come to me, and in which I have been called in consultation, where the patient had a rapid change from the formation of serous effusion into that of pus, and the general infection of the system, as illustrated by the following case:

M. R. æt. four years; history of tuberculosis on maternal and paternal sides. Case came under observation July 3, 1908.

Previous history: Supposed to have had enteric fever when an infant; a year ago suffered from quite a severe attack of whooping cough; ten weeks ago had an attack of measles, later followed by pneumonia. In the early part of the attack of measles patient had otitis media of right ear, and which soon discharged quite freely. About this time left knee began to swell, and a week later swelling of the right shoulder. At the end of five weeks drainage tube was introduced and pus drained from bursa of left knee and abscess about right shoulder. Two weeks later empyema presented and trocar used, with introduction of rubber drainage tube in right pleural cavity. Knee and shoulder improved but drainage from side not satisfactory. July 3, 1908, two ribs were thoroughly resected and an abscess containing about 500 c.c. of purulent fluid escaped. Drainage continued very profuse. From this time on patient improved rapidly and has made a splendid recovery.

That repeated cases of pneumonia often deceive the general practitioner, regarding the complication of empyema, and as to the possibility of tuberculosis being present, is, in my mind, a fact.

I have sometimes witnessed a very earnest discussion, on consultation, as to whether the case was one of simple plastic pleurisy, one of chronic consolidation, or one of true empyema, and I have no doubt in my mind that there are many cases of pneumonia associated with pleurisy in which an unexpected condition of empyema creeps in and is present without being recognized as promptly as it should by the family physician. The following case, one of many, is of some value in illustrating this point:

J. W., æt. 45 years, farmer by occupation. May 8, 1908, suffered from pain in right side, and in June had an attack of

pneumonia, same side. This was followed by attacks of coughing and pain on inspiration. Cough paroxysmal, which had persisted since onset, usually occurring during morning hours, at which time patient expectorated freely, coughing up profuse secretion, described as resembling oyster juice, with sweetish taste, but free from odor. At times he had expectorated a quart of this material, and not infrequently a pint or more. During attacks pain was present on right side of chest. Had lost in weight and strength. No history of night sweats; otherwise history negative. There was much discussion as to the case being one of tuberculosis or consolidation from pneumonia, possibly plastic pleurisy, but with no admission as to empyema being present. Blood count did not show a leucocytosis above 6250. Frequent examination of sputum showed an enormous number of pus cells, but no tuberculosis.

May 14, 1908, I believed the patient was suffering from empyema, and did a thorough resection of the fifth and sixth ribs, opening into a large abscess cavity with an adhesion to the fourth and fifth ribs and to the pleura that acted, as the lung had contracted, to give it the appearance of an hour-glass contraction. These adhesions were loosened and revealed a free opening into a large bronchus, also marked necrosis of the ribs. This cavity was well packed with three large tampons of sterile gauze and around a large rubber drainage tube. The patient made an uninterrupted recovery, cough abating at once, expectoration ceased, he gained rapidly in flesh and has made a good recovery, with the exception of a slight sinus, about two or three inches in depth which remained when he was last examined, April 1, 1909. The lung had returned to its normal condition regarding function. It is very impressive to note how cases of empyema will go on, the patients remaining invalids, and treated for one condition and another, but when at last reached are not unlike those of neglected appendicitis.

For some time I have discouraged the use of iodoform gauze as a dressing, and for treatment of the large cavity that remains after resection of the ribs I make use of either vermiform or just plain sterilized gauze. I believe it is well to pack the cavity somewhat firmly at first, so that the lung is not embarrassed by the lack of support, the patient is made

more comfortable, and then, at the end of forty-eight hours removed and packed much more lightly.

The use of the hypodermic syringe as a means of diagnosis is of vast help; the use of the aspirator in evacuating a chest that contains aseptic fluids is to be commended, and the use of the instrument can be repeated a number of times, but great care should be exercised in the laboratory examination of the fluid withdrawn, the least indication of pus that presents being a warning for the abandonment of this method.

I have been greatly impressed with the reports coming from the laboratory regarding the mixed infection that presents in cases of empyema, and how very seldom the bacilli of tuberculosis are found.

I have also been very much impressed regarding the length of time that pus has existed, or where the condition of empyema has been present, in the cases that have come under my observation, and of which the following are but illustrations of others:

G. F. C., æt. thirty-nine years, salesman by occupation, came under observation November 7, 1904. Patient had had diseases of childhood, during which time he was supposed to have had pleurisy.

Present illness: Four years ago was ill for three days with a diagnosis of pleurisy of right side. Recovered and apparently well for two years when an abscess presented to the right of right nipple, which was lanced, discharged quite freely, healed for some time, formed again later and discharged for six months. Then another abscess formed nearer nipple which was also lanced. This has been discharging ever since, and particularly profuse for past four weeks. Patient's weight has remained about the same. This abscess was very annoying in getting about to his business.

I advised resection of ribs, which was done November 8, 1904, resecting about four inches in length of fifth, sixth and seventh ribs, when an abscess was opened into, connecting with the sinus, abscess extending from apex of the lung to the diaphragm and having a capacity of about thirty fluid ounces. Lung completely walled off, and surface of the pleural cavity lined with a thick calcareous coating. The latter was dissected out as much as pos-

sible and cavity then packed with plain gauze around a large rubber drainage tube. Gauze gradually removed and drainage tube relied upon, through which irrigation was kept up, patient making a good recovery. January 6, and March 12, 1905, family physician, as well as patient, reported a steady improvement. Again in the spring of 1906 report came that he was doing well but a short sinus persisted. Lung had expanded well.

I have been interested in noting the phosphatic deposits that are found in long-standing cases of infection of the pleura, and I believe that better results come from attempting to dissect out, as carefully as possible, that portion of the thickened pleura which can be reached.

Cases of empyema or multiple abscess, particularly in children, are the ones to watch with prompt care, and we should not fail to make our operations thorough. I fear that at times we fail, perhaps, in giving full relief, as the following case illustrates:

M. H., æt. six years, came under observation February 12, 1904. Principal symptom that of a persistent cough and P.M. temperature. Family history negative. Whooping cough at the age of three years, followed by measles in the winter of 1901. This followed in turn by what was believed to be bronchitis which left her with a cough resisting all treatment and which has persisted ever since. May, 1903, had bronchial pneumonia, recovered and apparently well except for the cough. About four weeks ago child's temperature would rise at three P.M. to 102–103. This would persist until seven P.M., when it would gradually abate. Has been greatly weakened by a persistent diarrhœa. Appetite not good. In coughing raises nothing but white, mucus-like substance; no tubercular bacilli present on examination. About this time an abscess formed in right side of chest and discharged quite freely. There was much dulness on percussion, with zones of respiratory murmur. The case believed to be one of empyema unrelieved by the sinus, and an operation advised. Sixth and seventh ribs resected, one and one-half to two inches in length, and abscess cavity opened into just above the termination of the old sinus. Quite an amount of pus escaped and cavity packed with iodoform gauze. Operation fifteen min-

utes, under chloroform. Bacteriological examination at the Bender Laboratory showed cocci and bacilli, and cultures showed diplococcus pneumonia. Patient improved somewhat at first, was much more comfortable, but temperature gradually increased, reaching 107.6°, then declined to 105° when she died somewhat unexpectedly. No autopsy. I believe this patient was suffering from multiple abscesses and entire relief was not afforded.

The next case is somewhat in contrast:

I. E., æt. six years, came under observation January 9, 1905. September 21, 1904, had suffered pain in chest, vomiting, fever, loss of appetite and severe cold. Child treated for typhoid fever for five weeks. Previous history had always been good. Now another physician called who diagnosed empyema. Patient was sent to a local hospital, where two incisions were made in side, but with negative results. January 9, 1905, patient was brought to the Albany Hospital and resection of ribs determined upon, believing the child was suffering from empyema. Thorough resection of fifth rib done and cavity opened into very promptly. In introducing fingers two or three cavities were distinctly located and opened. Gauze tampon used for drainage for some few days, then rubber drainage tube, and irrigation. Respiration had been rapid but gradually dropped to twenty-four. Temperature for first few days between 100° and 100.5°, then gradually came down to about normal. This patient made a good recovery.

As a contrast to the first case of gunshot wound reported in this paper the following is somewhat interesting:

P. S., Hungarian, æt. 27, during a quarrel on the night of November 2, 1908, was shot in the right side and fourth rib severely fractured. He was brought to the hospital at once, and the same day my son, Dr. Edgar, opened the wound freely, removed a good portion of the rib, recovered the bullet, found pleura quite badly lacerated, some considerable hemorrhage, and wound packed with plain gauze around rubber drainage tube. Patient somewhat uncomfortable a few days after the operation; some difficulty in breathing; temperature at one time 103°, some purulent discharge, but all these conditions abated gradually and patient made a good recovery.

In the study of cases that have come to me, and in some of my own, I have been somewhat disconcerted by having them go on nicely after thorough resection of the ribs, but finally ending in a sinus that was exceedingly troublesome and difficult to close. For instance, Mr. D. gives a good representation of this condition, and upon this point I trust we may hear some discussion:

M. M. D., ætat 34, agent by occupation, had typhoid pneumonia ten years ago, followed by empyema. An abscess followed later and for eight years sinus in right side had persisted. He had kept this sinus open, which led from pleural cavity, and discharge very slight. April 24, 1907, patient very anxious for permanent relief, condition incapacitating him for work and he wanted to get well. General condition otherwise very good. He entered the Albany Hospital and resection to the extent of three inches was done in sixth, seventh and eighth ribs, in axillary line, right side, and quite an extensive abscess cavity was opened into. Patient went on to complete recovery, gained in flesh, returned to his work, and able to do as much as ever, but December, 1908, there was yet a sinus about four or five inches in length which would hold about one-half ounce, which would not heal under any form of treatment followed out.

In the chronic state of these sinuses I would be very glad to hear from any of our associates who have had an experience in the use of paraffin in the treatment of these cases.

In the treatment of sinuses I am quite sure that the drainage tube or method of drainage is somewhat responsible, that at times the packing is too earnest and the tube is left in too long, not granting sufficient opportunity for the expansion of the lung. Where the lung does expand rapidly a sinus is not so likely to form. This is one point I believe in favor of an early operation, therefore, I use it as an argument with the family physician to avoid delay in these cases.

In the study of my cases of empyema I have been greatly impressed to note what a large proportion occur on the right side.

As remarked, it is most impressive to note the duration of the history of cases of empyema and their association with what might be termed a tubercular predisposition.

J. W. B., æt. 39, a bottler by occupation, came under observation May 18, 1903. One sister had died of tuberculosis. Sputum thoroughly examined and negative of tuberculosis. Blood examination: Leucocytosis 8000, and many polynuclear leucocytes present. Patient gave a history of cough and expectoration of blood for fifteen years. Four years ago had a distinct pleurisy in left side, since which time noticed respiration had been difficult and somewhat rapid. November, 1902, contracted a severe cold and since then unable to work. His family physician made the diagnosis of empyema and did two aspirations, but with little benefit. May, 1903, an abscess was opened between eighth and ninth ribs, under ethel chloride, and a large amount of pus evacuated. On May 19 another incision was made with a somewhat similar result, but his symptoms did not improve, temperature not lessened, and he was advised to enter the Albany Hospital. May 27 I did a thorough operation and found a sinus that extended to the intercostal space between the eighth and ninth ribs, which was carefully dissected out, and which had communicated with the pleural cavity. Seventh and eighth ribs resected to the extent of nearly four inches, this opening into a large abscess cavity from which a pint of pus was evacuated. A large rubber drainage tube inserted and packed about with iodoform gauze. Gauze removed at the end of forty-eight hours and abscess cavity irrigated with boric acid solution, a drachm to the pint. After this operation his temperature became normal, cough ceased, appetite returned, general functions of the body became normal, and patient left the hospital at the end of the third week, improving in every respect and ultimately making a good recovery. I regret to say the hospital record fails to note and report on examination of sputum, on his discharge, for tuberculosis. His clinical history and appearance was that of tubercular trouble.

In a number of my operations for the relief of empyema I have seen good results following the bottle method of exercising the lung to produce expansion.

Summary.—1. That the hypodermic syringe, with a long needle, is of value for exploratory purposes.

2. That the repeated use of the aspirator is not to be condemned so long as the fluid remains sterile, and its use is the preferable method of treatment in malignant cases.

3. That the use of the trocar and drainage tube is advisable after it is shown that the aspirator is no longer affording benefit.

4. That resection of the ribs is absolutely necessary when no improvement takes place with the ordinary drainage tube.

5. The latter operation to be done early, in order to protect the lung from unnecessary pressure and to relieve the adhesions that, in the young, become so detrimental in causing spinal curvature.

ŒSOPHAGOGASTROSTOMY AFTER INTRATHORACIC RESECTION OF THE ŒSOPHAGUS.*

BY WILLY MEYER, M.D.,

OF NEW YORK,

Professor of Surgery at the New York Post-Graduate Medical School and Hospital; Attending Surgeon to the German Hospital; Consulting Surgeon to the New York Skin and Cancer Hospital, and New York Infirmary.

SINCE the last portion of the body, the thoracic cavity, has been definitely opened to surgery as a result of the introduction of the principle of operating under differential air pressure, the treatment of the diseases of the organs situated within the chest as well as the diseases of the chest wall itself, has, of course, become greatly facilitated.

Next to pleura, lungs and heart, it is the œsophagus that now can be safely attacked by the surgeon also in its thoracic portion. While access to the other organs named has been had before the advent of operations under differential pressure, there is great risk connected with such operations in view of the always threatening pneumothorax. Still there was at least a possibility of doing the work. It has been different with the œsophagus in its thoracic portion. This has always been a *noli me tangere,* at least as far as a direct route through the thoracic wall was concerned, and this owing to the fact that as soon as the œsophagus is lifted out of its bed both pleural cavities are liable to be opened. Thanks to the work of Sauerbruch and Brauer we now have access also to the œsophagus by the straight, direct route, with the same safety with which we approach the intra-abdominal organs.

Of the various diseases of the œsophagus it is principally cancer—this up-to-date inevitably fatal disease of the œsophagus—which has now been placed within the focus of surgical interest and attack. So far every single patient with malignant stricture has had to die of the disease. When such a case

* Read before the American Surgical Association, June 4, 1909.

came under our care, we usually took the family into our confidence, stating the helplessness of operative surgery in this particular affliction and admitting that the patient was absolutely doomed. The latter usually was told for humane reasons that a stricture existed between mouth and stomach, for which a gastric fistula would have to be established, to prevent death from starvation, and that, by feeding through the tube and giving rest to the diseased part of the œsophagus for a time, the constriction would probably yield within a few months. And when the "few months" had passed, the patient also was usually ready to pass away. Others condemned all operative treatment in these cases and kept the passage to the stomach patent with the help of bougies regularly introduced as long as this was possible, soothing the patient with hopes that could, of course, never be realized: And all this in dealing with a carcinoma, that may well be pronounced the most benign of all of them, one that has little tendency to produce early metastases, and affects the glands only when the border lines of the œsophagus itself have been transgressed by the disease. I say, all this with a carcinoma the presence of which, even in its early stages, can be diagnosed without much difficulty.

It was but natural that with the introduction of differential pressure operations five years ago great hopes were at once entertained as to our being able to take up at last the cudgels also against this disease and to combat it successfully.

While it may be disappointing that so far, out of about twenty patients operated upon for cancer of the œsophagus, by six different European surgeons, not one has recovered, it is to be regretted that such a small number of failures should have induced Sauerbruch to say in his latest publication on this subject, which appeared only two months ago (*Deutsche Zeitschr. f. Chir.*, vol. xcviii 2 and 3, March, 1909), that his hopes of obtaining success in operating for œsophageal carcinoma are greatly reduced and that the indications for operative interference must be drawn extremely narrow.

The cause of the unsatisfactory results has been: First the

great advance the disease had already made in most of the cases cited by him when they came under the knife; Secondly, the extreme sensitiveness of the pleura and especially of the loose connective tissue of the posterior mediastinum to the highly infectious mucous secretions of the œsophagus, and that in spite of the most rigid asepsis; Thirdly, the absence of a pleural cover to the lower third of the œsophagus; Fourthly, the lack of a safe method of operation.

Still, it seems to me that the only way to make progress in the direction of combating œsophageal cancer, is to go right on, regardless of past failures, endeavoring to improve our methods and to try to overcome the many obstacles; to encourage, rather than to discourage the profession as well as the laity to have an *exploratory thoracotomy* made in every instance, where the suspicion of the presence of an œsophageal carcinoma has arisen. That is the time when the attempt should be made to save the patient. Without operation the patient is absolutely lost; with it he has at least a chance.

Of course, if a major operation is refused, after exploratory thoracotomy has revealed a suspected carcinoma, the wound must be closed and the patient left to his fate. With the help of a gastric fistula his life may perhaps be prolonged, but his only chance of a cure has been irreparably and irrevocably lost. Here, as well as with cancer elsewhere, early diagnosis to be followed up with prompt and proper surgical intervention, is the all important point.

It is certainly true that personally, I cannot so far point to a single case of œsophagogastrostomy performed on the human subject. I have done but one exploratory thoracotomy for cancer of the œsophagus on a human, and my opinion may, therefore, not be of much weight when compared with that of our more experienced European colleagues. My deductions are made from the history of the operative treatment of cancer of the stomach. Did we not there too have difficulties to overcome, which in the beginning looked almost insurmountable? Did the first twenty mishaps in that field discourage us from continuing our efforts to obtain better results?

Think of the great mortality observed during the first years of gastrectomy for carcinoma and the greatly improved results obtained to-day. Surely, deductions based on but five years' work in attacking œsophageal carcinoma, the most difficult task in all surgery, can have no claim to being considered conclusive. Even should the first 50 or 100 or 200 cases operated upon for cancer of the œsophagus die, may be the 51st, 101st or 201st will live. They are lost anyway, and what a terrible death most of them do die!

When I commenced my research work in intrathoracic surgery on dogs at the Rockefeller Institute of New York City, in the middle of November, 1908, one of my aims was the finding of a method of œsophagogastrostomy after resection of the œsophagus, that would answer the requirements of everyday practical surgery, a method, which should come nearest to excluding the possibility of infection following the dividing of the œsophagus, insure a reliable approximation, avoid leakage after the approximation has been made and maintain the necessary patency of the canal.

I hope I have found a method which comes up to most, if not all of these requirements. In working it out, the leading idea has been to avoid penetrating the wall of the proximal stump of the œsophagus laterally. Only in this way is the surgeon able to prevent exit even of a drop of the highly infectious contents of the œsophagus above the stricture. There is no other way of accomplishing that than to implant the temporarily tied proximal stump of the œsophagus into the stomach.

In my work at the Rockefeller Institute I was assisted by Dr. Martin Rehling, my adjunct attending surgeon at the German Hospital. I gladly take also this opportunity of expressing to him my sincere thanks for his most faithful and able help and the many excellent suggestions he made in the course of our work. No less am I indebted to Dr. Edward Adams, formerly of the house staff of the German Hospital, now instructor in surgery at the New York Post-Graduate Medical School and Hospital, who, with an attendant, reg-

ularly conducted the general anæsthesia in my operations. Further members of the crew required for the work were, a nurse to hand instruments, sponges and dressings, and a man whose only business it was to attend to the setting of the valves and to the proper regulation of the differential pressure.

Before describing my operative method as I have evolved it in the course of my experimental work during the last six months, it would seem proper to say a few words on the apparatus used.

The portable chamber which Dr. Sauerbruch courteously left here for my use last summer, after he had shown it before the surgical section of the American Medical Association at its Chicago meeting in June, permits of work under positive as well as negative pressure. For operations under partial vacuum, everything required for an operation had, of course, to be taken inside of the cabinet before its door was closed; and, once the vacuum established, the door could not be opened again. Communication with the outside world was then cut off. Under this arrangement the anæsthetizer sat outside of the box. The chamber was so small, that with surgeon and assistant placed inside, it was impossible to maintain proper asepsis. Consequently I reversed the order of things, put the narcotizer inside of the chamber under increased pressure and doing my work outside of it under atmospheric pressure.

During all this time I proceeded with the getting up of a different kind of apparatus.

It was built for me under my direction and guidance by my brother Julius Meyer, an engineer by profession. The first completed specimen thereof was brought into the Rockefeller Institute on January 8, 1909. This new apparatus, a "Positive Differential Pressure Chamber," has a great many advantages over all other similar apparatus so far known. It will be fully described in a separate article.

I have used the apparatus for the last four months to my entire satisfaction.

An improved chamber of this kind, arranged with an air-

lock for the admission or exit of one of the two narcotizers in the course of the work, with the necessary machinery mounted on a small cart (power truck), was placed in the German Hospital early in March and has meanwhile been successfully tested there in a number of operations on human beings.

Next I had constructed a chamber in which it is possible to operate either under positive or under negative differential pressure, or under a combination of the two, and which, further, allows the changing from one pressure to the other in the course of one and the same operation, a thing unattainable with any one of the preceding apparatus. Formerly an operation had to be finished under the same kind of pressure under which it had been commenced.

Of this universal differential pressure chamber the aforementioned "positive differential pressure chamber" forms a part.

The universal chamber was completed in April and installed for me at the Rockefeller Institute by my brother at the end of that month. I have used it since May 7th and have been very much pleased with its smooth working. With the aid of this apparatus I will attempt to establish, whether there are indications for the use of negative or positive or a mixed pressure in the case of the diseased human being. The surgeon with his assistants and attendants remains therein in the same place, no matter which kind of pressure be used.

A detailed description also of this apparatus will soon appear in another article.

After this conversion into the developing of improved tools I will now proceed with the description of the work performed with the same.

When resecting the œsophagus, we must be mindful of the fact that this tube cannot be stretched for the purpose of approximating the two ends. The stomach must, therefore, be brought up into the thorax for anastomosis to the proximal portion of the œsophagus, while the distal end is closed and dropped back.

In operating for cancer of the œsophagus, two ways are open to the surgeon:

1. Gaining blunt entrance into the abdominal cavity next to the cardia; transposition of the stomach into the thorax; closure of the rent in the diaphragm by stitching it on to the stomach; resection of the diseased portion of the œsophagus; œsophagogastrostomy.

2. Resection of the diseased portion of the œsophagus; closure of both ends; gastrostomy for permanent feeding.

This method is indicated in cases in which the carcinoma has invaded the upper portion of the intrathoracic part of the œsophagus (behind the aortic arch, for instance). Usually the stomach will not be found sufficiently large, to be pulled up to this place.

Further experience is necessary to find out whether the operative closure of the upper portion of the œsophagus is as well borne. It may be shown that preference should be given to the establishment of an œsophageal fistula in an intercostal space. Still more preferable seems, to pull up a coil of the upper portion of the jejunum into the thorax, and perform œsophagojejunostomy, thus overcoming the annoyance of a permanent gastric fistula.

It is wise to start operation No. 1 with pulling up the stomach above the diaphragm. The amount of its yielding must guide the surgeon in his decision as to which of the two methods had better be employed. Of course, the first is the operation of choice.

The necessity of establishing a permanent gastric fistula for the remainder of the patient's life should not discourage the operator. The writer has a young man of 18 under observation, who was operated upon when a boy five years of age, for an impermeable cicatricial stricture of the œsophagus. The boy has since then, *i.e.* for a period of 13 years, been fed through the gastric fistula that had to be established, and has nevertheless grown up to be a fine strong man.*

* *Cf.* Medical News, October 29, 1904, and ANNALS OF SURGERY, vol. xlix, p. 260, 1909.

The various steps of the operation as carried out and recommended by the writer to-day are as follows:

1. Incision best in the eighth intercostal space,* in order to be able to easily approach the cardia and determine whether the stomach can be properly pulled into the thoracic cavity. Rib spread or put in place. (Fig. 1.)

Of course, before this, the seat of the disease which had previously been located with the help of the bougie, X-rays (bismuth), and œsophagoscope is investigated by direct palpation.

2. Lung pushed upward and inward by gauze tampons, and œsophagus, with nervi vagi and aorta running along its side, come into view (Fig. 2).

3. The œsophagus is raised from its bed. The surgeon's left forefinger surrounds the œsophagus; nervi vagi stripped off. In doing this the opposite thoracic cavity is frequently opened. No harm results therefrom when working under differential pressure (Fig. 3).†

4. Œsophagus with cardia is pulled up by the left hand, thus putting diaphragm on the stretch. An anatomical forceps is pushed parallel with and to the right of the œsophagus into the abdominal cavity (Fig. 4).

5. By flexing second phalanx of thumb, which rests on the cardia, the stomach wall is rolled upward, grasped with anatomical forceps and then pulled into the thoracic cavity by hand (Fig. 5).

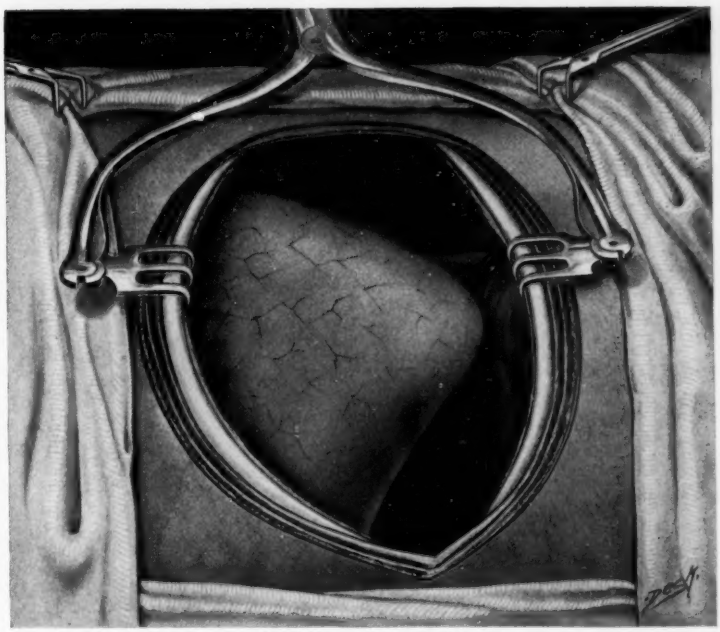
6. The rent in the diaphragm is grasped with a number of tenaculum forceps, care being taken to catch below the diaphragmatic peritoneum. This point is of very great importance, as only by including this part of the peritoneum a rapid and thorough agglutination between stomach and diaphragm can be expected (Fig. 6).

7. Diaphragm stitched to stomach with the help of silk sutures, the assistant pulling on the forceps and the operator introducing his left

* In dogs the incision in the seventh intercostal space suffices to enable one to do the work including the resection of the œsophagus and the subsequent œsophagogastrostomy, provided only a short piece (not longer than an inch) of the œsophageal tube is excised. If a larger piece is removed, the work with needle and thread becomes unsafe, if not impossible, and a second intercostal incision a little higher up, say in the fifth or sixth intercostal space, will be required. Dogs stand this double incision very nicely. With the greater length of the human thorax this double incision also seems practical, if the surgeon does not prefer a flap formation or the removal of a number of ribs. The preliminary operation on the chest wall will have to be adapted to the individual case. In order not to have the two incisions too close together, I selected the incision in the eighth interspace instead of in the seventh, which latter has so far been preferred by other operators.

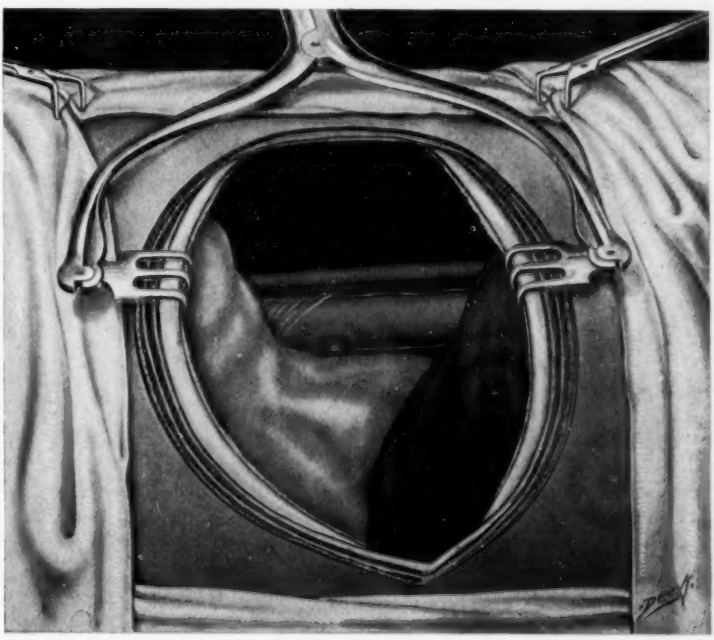
† The wearing of cotton gloves greatly facilitates intrathoracic work. These gloves always give one a firm hold on the organs, which are rather slippery to the bare hand, still more so, of course, when the hands are covered with rubber gloves. I have used cotton gloves in aseptic intrathoracic operations right from the start and should not like to do without them.

FIG. 1.



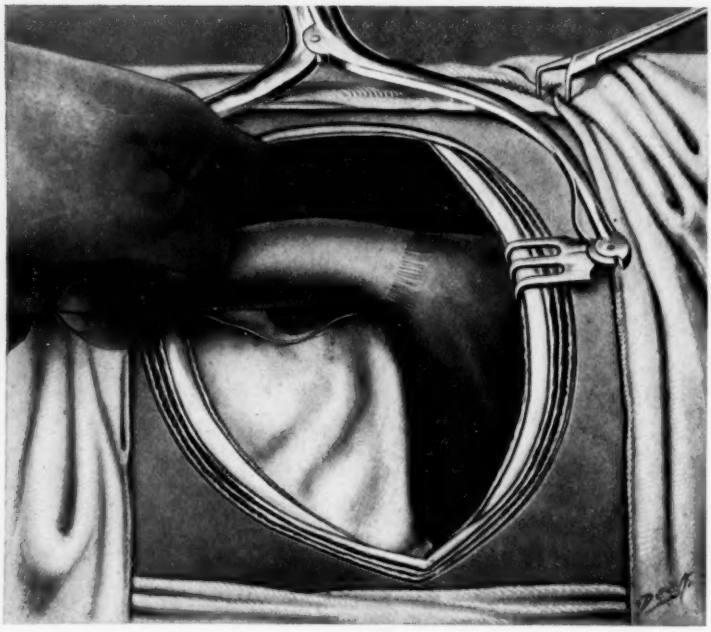
Intercostal incision in eighth interspace. Rib spreader in place; to the left, inflated lung as it presents itself under differential pressure; diaphragm to the right, descending aorta and ribs in the background.

FIG. 2.



Lung pushed aside by gauze tampon; œsophagus showing in depth of wound, partly covered by pleura; nervi vagi on either side.

FIG. 3.

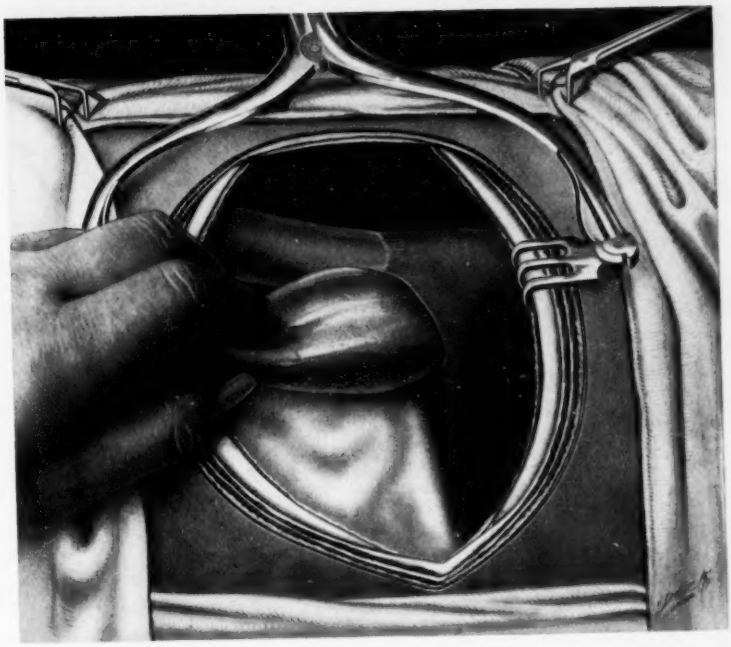


Œsophagus raised, surgeon's forefinger surrounding it. Nervi vagi stripped off.

FIG. 4.

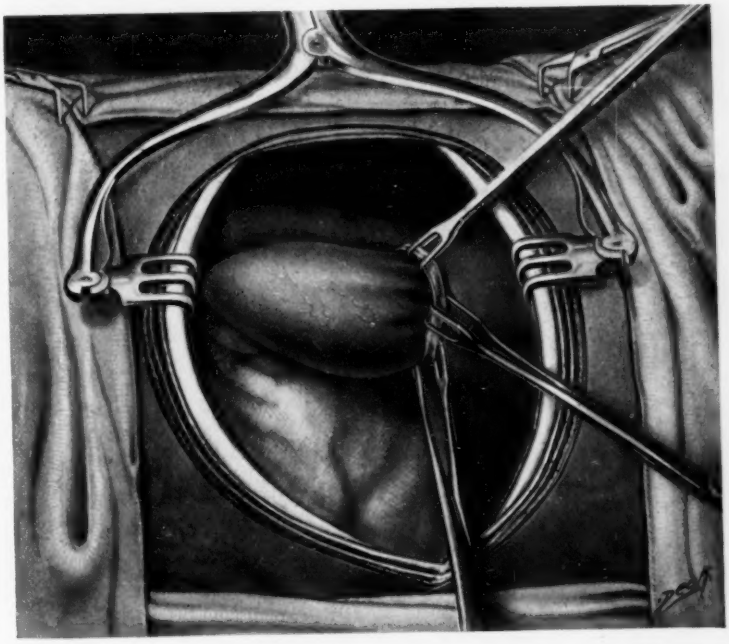
Œsophagus, with entrance to stomach, plus diaphragm pulled upward by left hand; anatomical forceps bluntly entering abdominal cavity to left of cardia. (Forceps in reality inclined more obliquely.)

FIG. 5.



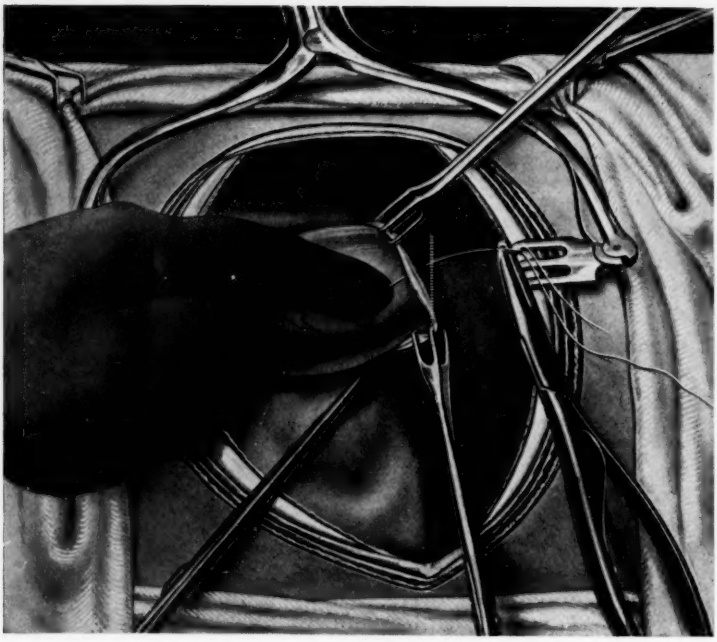
Stomach pulled into thoracic cavity.

FIG. 6.



Rent in diaphragm, with diaphragmatic peritoneum caught by tenaculum forceps.

FIG. 7.

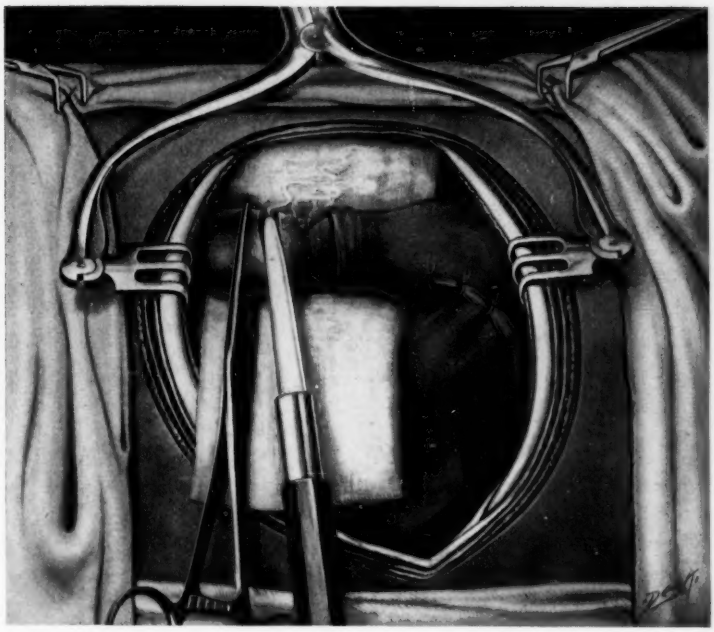


Silk sutures through diaphragm and wall of stomach. Surgeon's left forefinger emerging from abdominal cavity with tip of needle.

FIG. 8.

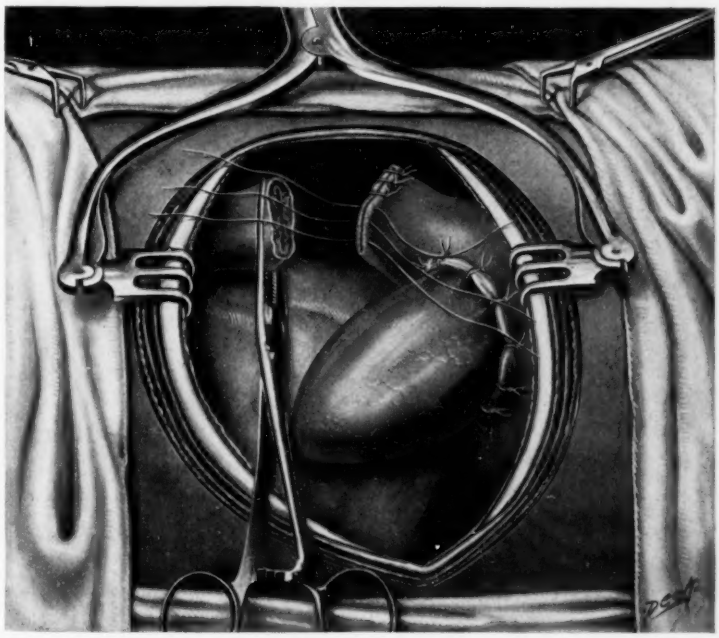
Forefinger surrounding œsophagus; circular incision of muscular coat to form cuff.

FIG. 9.



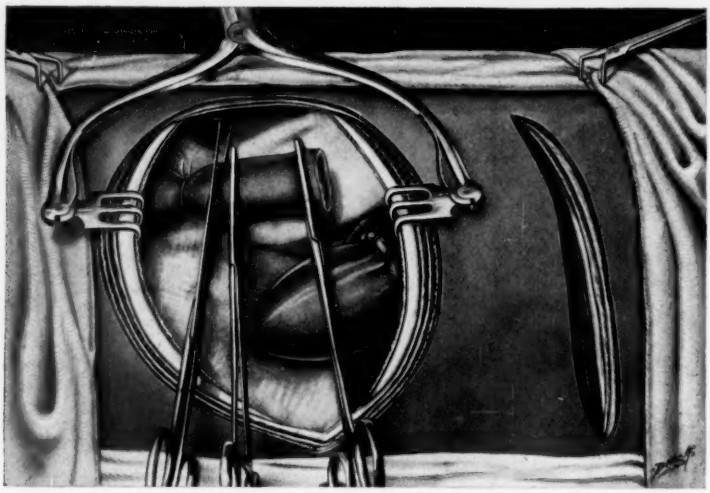
Diaphragmatic rent closed and sutures cut short; narrow tampon below œsophagus; tampon covering stomach not shown. Cuff turned back; inner coat of œsophagus tied and burnt off with Paquelin cautery, clamp closing proximal side of œsophagus.

FIG. 10.



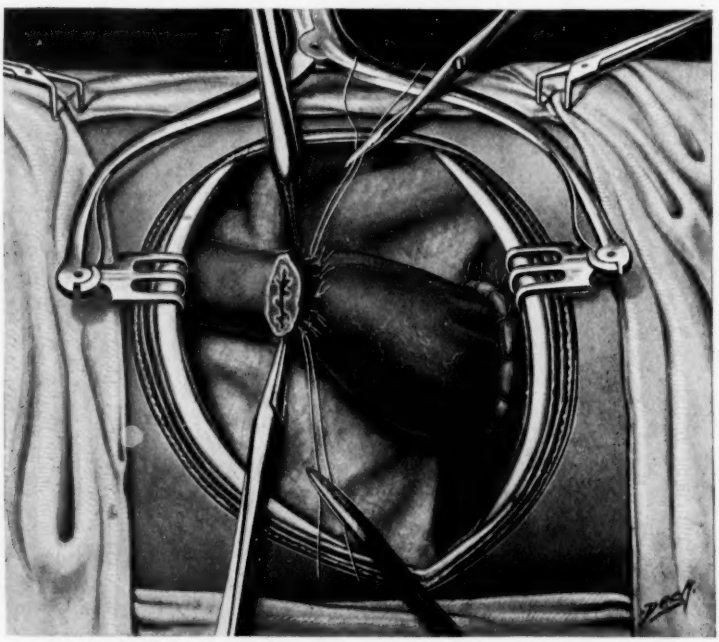
Suturing cuff; to the left, cauterized surface of proximal end of œsophagus.

FIG. 11.



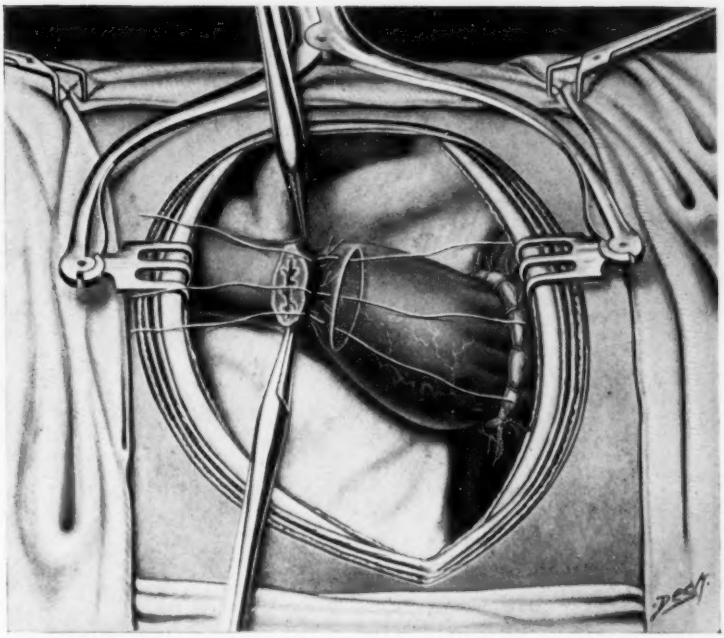
Distal œsophageal stump dropped back, covered with tampon; large curved clamp gently compresses stomach above diaphragm (not shown); second intercostal incision in fifth interspace; upper portion of œsophagus tied with rapidly absorbable catgut ligature; second clamp distally from it; scissors dividing œsophagus.

FIG. 12.



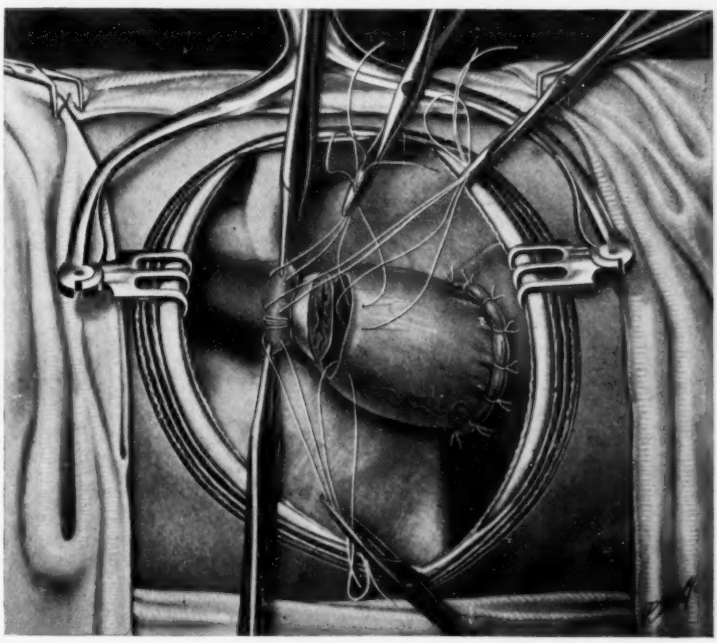
Stump of divided œsophagus drawn up by means of two forceps; wall of stomach stitched to posterior wall of œsophagus by means of silk sutures, which grasp muscularis only; the two farthest sutures, to right and left, clamped to serve as guides later on.

FIG. 13.



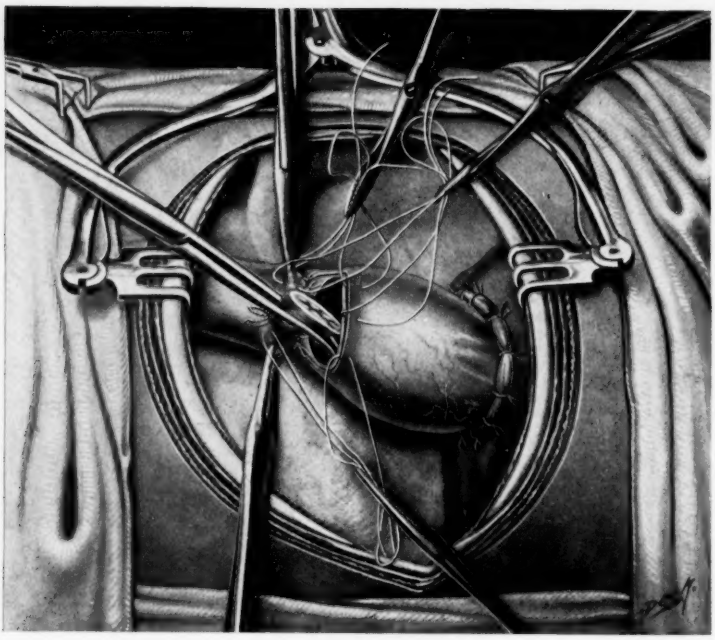
Ellipsoid-shaped excision of seromuscular coat of stomach in a horizontal direction, about three-quarters inch in front of the sutures, showing in depth mucous membrane of stomach not yet divided; the two long lateral sutures shown in Figure 12 omitted in this illustration. Upper lip of stomach wound caught with three sutures, not yet tied, uniting seromuscular coat of stomach with muscularis of œsophagus.

FIG. 14.



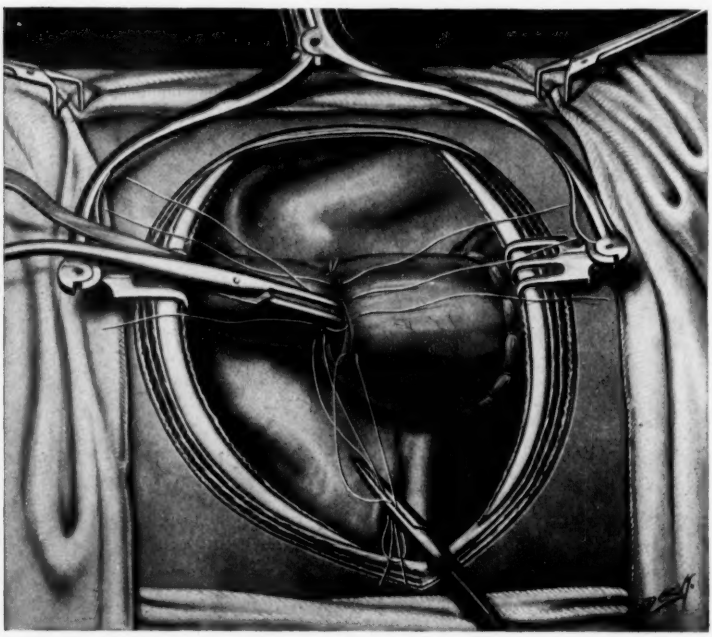
Lower lip of stomach wound and anterior wall of œsophagus caught by long silk sutures, untied, the middle portion of each suture and its two ends caught by an artery clamp.

FIG. 15.



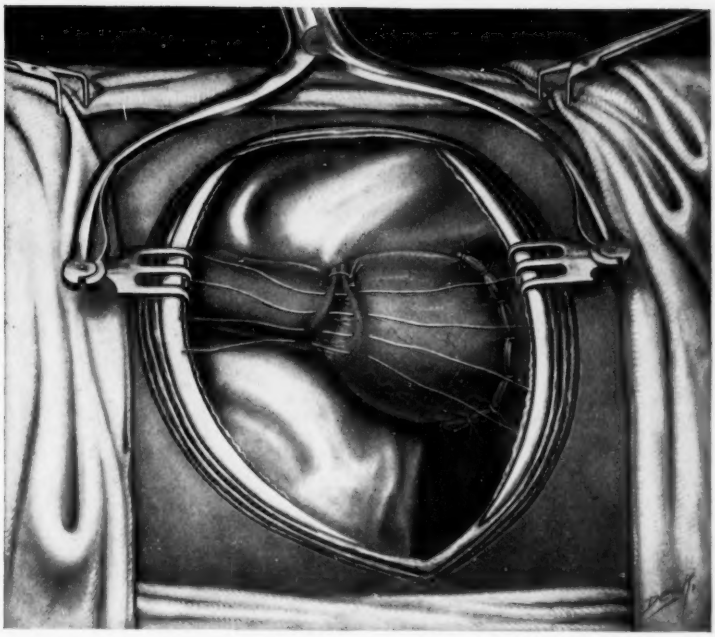
Anterior sutures separated; lower end of œsophagus caught with curved forceps for introduction into stomach.

FIG. 16.



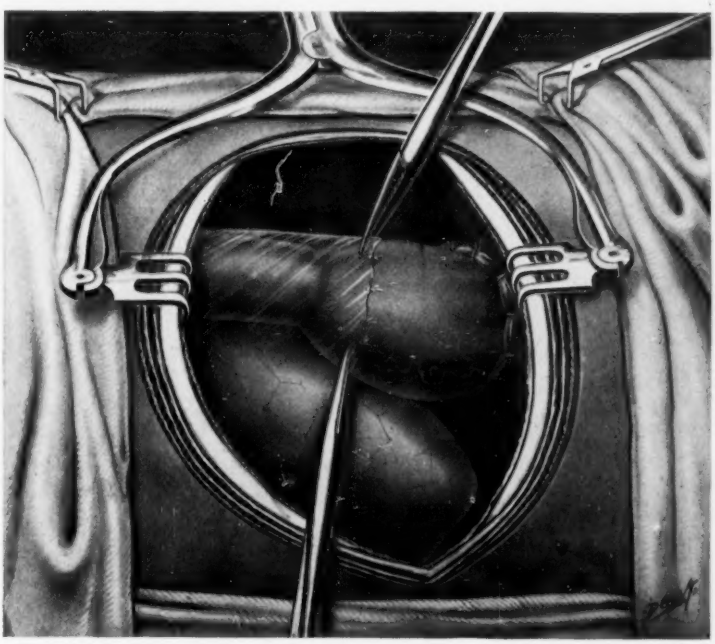
Implantation perfected, closing anterior sutures. Forceps withdrawn when tying middle suture.

FIG. 17.



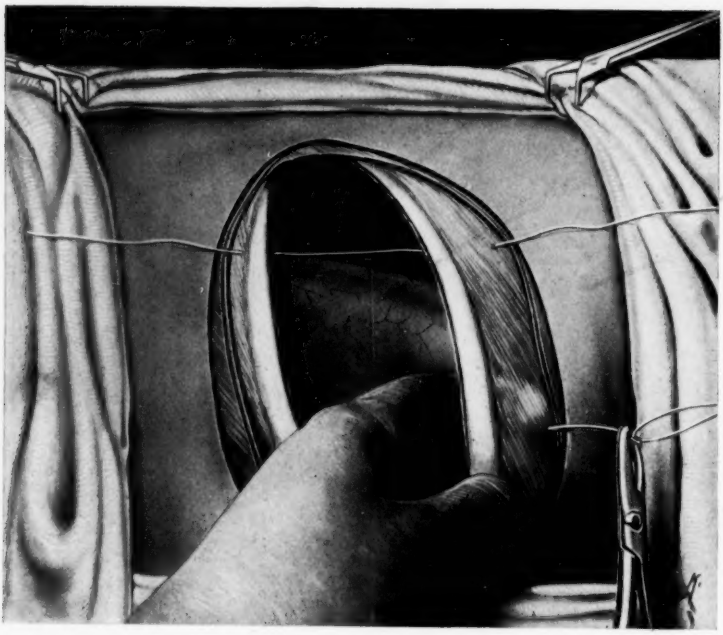
Forceps removed; first row of anterior sutures tied. Second row in progress, to cover front row by drawing a fold of the stomach up to anterior wall of œsophagus.

FIG. 18.



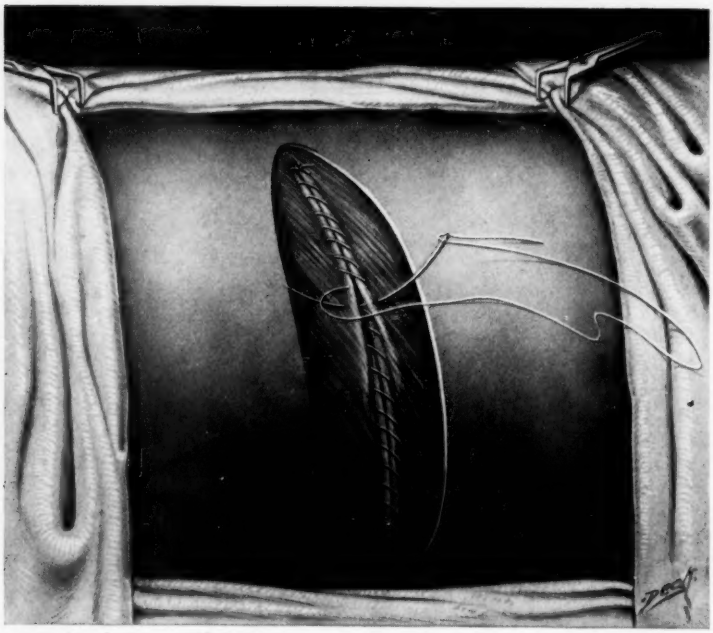
Tampons removed; œsophagus in its normal position, next to spinal column; lower border of pleura, caught with two forceps, stitched onto stomach; anastomosis, seen through pleura, within posterior mediastinum.

FIG. 19.



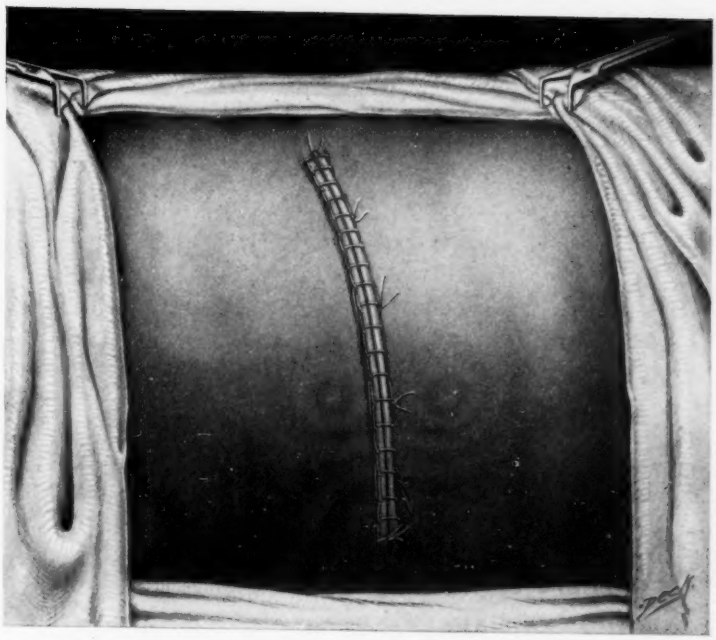
Placing pericostal silk sutures, avoiding intercostal arteries; left forefinger of surgeon raising lower intercostal space preparatory to introduction of needle at upper border of next rib below.

FIG. 20.



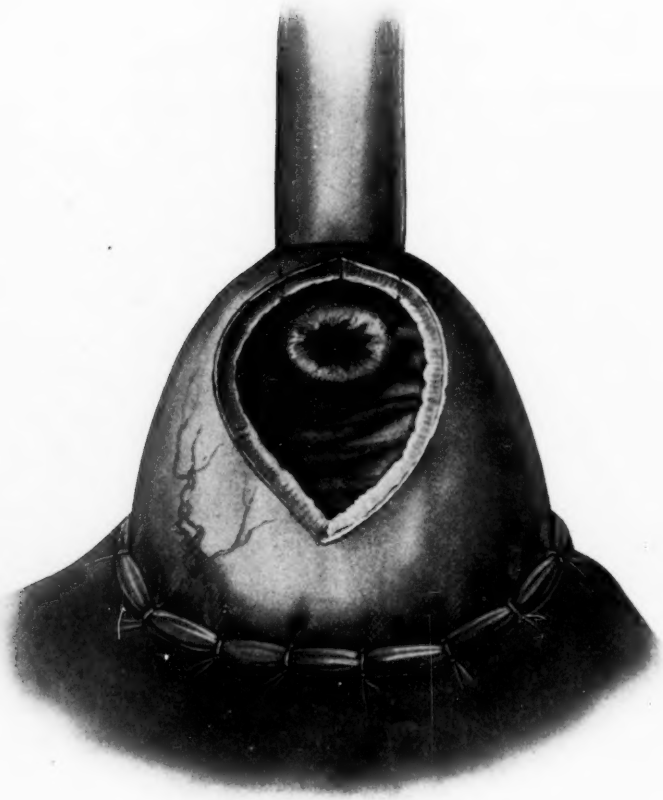
Pericostal sutures tied; first continuous catgut suture in place, uniting divided muscles and fasciæ; second suture under way.

FIG. 21.



Skin wound closed with interrupted retention sutures and continuous interlocking catgut suture. Wound in eighth intercostal space, closed in the same manner, not shown.

FIG. 22



Window cut in stomach wall, to show implanted end of œsophagus. (Drawn by artist, from specimen.)

FIG. 23.

Sketch, showing implanted end of œsophagus, which had been left unnecessarily long, as found inverted back into œsophagus, closing it tightly. (Drawn by artist, from specimen.)

forefinger into the abdominal cavity, receiving with the tip of his finger the tip of the needle. By thus guiding the tip of the needle he will be sure that no other tissue comes within the grasp of the needle (Fig. 7). Each suture, after having passed through diaphragm and gastric wall, is closed at once, its ends being left long and secured by forceps. Special care must be taken to do this work thoroughly. No space should remain, through which an abdominal organ might slip. If the distance between two sutures seems too long, additional, more superficial, intermittent sutures have to be placed. Every surgeon who has worked on dogs has a number of diaphragmatic herniæ to record that were found later on and frequently were the cause of death.

8. Diaphragmatic sutures cut short; tampon placed on intrathoracic portion of stomach; with surgeon's forefinger again surrounding œsophagus, a circular incision is made with the knife down to the fascial part of the tube (Fig. 8).

9. The muscular coat is pushed back and the inner layer (fascia plus mucosa), surrounded by a silk ligature, placed as tightly as possible and the œsophagus divided between this ligature and a clamp with Paquelin's cautery (Fig. 9).

10. The muscular coat is pulled over the divided end of the œsophagus by means of silk sutures (Fig. 10). If the muscular coat appears thick, a curved needle introduced parallel with the longitudinal axis of the œsophagus may be used; of course, it must not pierce the lumen. If the muscular layer be thin, a straight needle may be pushed at right angles to the longitudinal axis from right to left anteriorly and posteriorly, thus forming a mattress suture, for closure.

11. These sutures are tied, and the stump is dropped back, and a gauze tampon placed on top. The intrathoracic part of the stomach is raised, gently milking downward, and a curved long forceps with blades protected by rubber tubing, as used for gastro-enterostomy, is placed transversely around the stomach close to the diaphragm. Second intercostal incision in fifth interspace; œsophagus ligated with rapidly absorbable catgut (Levene),* making a single knot on either side, then securing the ends with a clamp; or making an ordinary double knot on one side only, with ends cut short,† a clamp placed distally;‡ division with scissors (Fig. 11). The cut end of the œsophagus is immediately mopped with lysol solution.

12. The stump of the divided œsophagus is drawn up by means of two forceps, with narrow tip and *without* mouse-teeth, best placed before

* This catgut has been kindly prepared for me by Dr. Th. A. Levene of the Rockefeller Institute. It is boiled for five minutes in a solution consisting of 5 per cent. soap (potassium soap preferred) and 95 per cent. alcohol.

† In order to be able to feed the dogs as soon as possible and not to be obliged to wait for the absorption of this catgut thread, it was tried in two cases to close the proximal end by means of a bow-knot and, after implantation of the cut end of the œsophagus into the stomach, remove the bow-knot by simply pulling on one of its ends before the last anterior suture was closed. The observation made in two of these cases,

dividing the tube, and a narrow compress of moist gauze placed in the depth of the wound from right to left, same as we are wont to do in performing gastro-enterostomy; the wall of the stomach is stitched to the posterior wall of the œsophagus by means of a number (5–7) of silk sutures. The two placed at the extreme end are left long and secured by forceps; the others are cut short (Fig. 12).

13. Transverse incision through seromuscular coat of stomach in horizontal direction, three-fourths inch in front of these sutures. If the stomach appears to be thick, an ellipsoid excision of the two upper gastric layers may be made. The mucous membrane of the stomach is not yet divided. The upper lip of this wound nearest the œsophagus is stitched above the first layer of sutures to the œsophagus, securing further proper adaptation of the two organs to be anastomosed. They are cut short (Fig. 13).

14. The lower lip of stomach wound exclusive of mucosa and anterior wall of œsophagus caught by five silk sutures, but not tied as yet, the middle portion and the two ends of the thread being caught by an artery clamp (Fig. 14).

15. Three of these sutures are pushed to the left and two to the right, or vice versa, in order to expose the mucous membrane of the stomach, which is now incised transversely for about three-fourths inch with scissors or knife (Fig. 15). The gastric mucosa is mopped clean with a small piece of gauze soaked in lysol.

16. Œsophageal stump introduced into stomach. The five sutures placed before are now drawn tight, the middle one being the last (Fig. 16). The latter is tied immediately after the clamp which has introduced the œsophagus has been gently withdrawn. A number of additional sutures are placed to secure the proper implantation of the œsophagus into the stomach.

17. Second row of anterior sutures bringing into apposition the serosa of the stomach and part of the œsophagus further up (Fig. 17).

18. Tampons removed and œsophagus allowed to slip back into its normal position next to spinal column. The lower border of pleura is caught with forceps, pulled over the seat of the anastomosis and stitched to the stomach, thus hiding the suture line from view and placing the anastomosis into the posterior mediastinum (Fig. 18). Care must be taken not to enclose the loop of the nervi vagi.

19. Two to three pericostal silk sutures are placed around the two adjacent ribs; they are then drawn tight and cut short (Fig. 19).

20. The soft tissues of the chest wall are closed by continuous catgut suture, layer by layer (Fig. 20).

---

that the œsophageal end within the stomach became inverted back into the tube, evidently in consequence of early vomiting spells and rapid agglutination of the muscularis, producing complete obstruction in this way, made me definitely abandon this otherwise simple and seemingly practical procedure. (See Fig. 23.)

‡ It is of importance to place this clamp over the ligature or just below the same *at once*. Observation was made repeatedly, that the air pressure from above distended the tube greatly and forced the ligature off.

21. Skin wound closed with 3 or 4 interrupted sutures, bringing the two sides in proper apposition. Continuous interlocking catgut sutures on top approximate the very edges of the skin wound.

The implantation, as it appears after completion of the operation, is illustrated by Fig. 22.

This kind of anastomosis was carried out in dogs eight times in all; after resection within the *lower third* of the œsophagus—this portion being supposed to be the seat of the disease—six times. Of this latter number three dogs died and three made an operative recovery. The causes of death were as follows:

One died within the first 12 hours after operation of secondary hemorrhage from a punctured diaphragmatic artery. One died 48 hours after operation of pneumothorax due to a tear in the lower lobe of the lung, which had been left unsutured, it having been produced by forcibly pulling the lung into the intercostal incision, when the belt of the pump slipped off the pulley and differential pressure was temporarily interrupted. (After that experiment a pump was substituted without a belt.) One died of septic pleuritic effusion with a well-functionating anastomosis, six days after operation.

Of the three that recovered of the operation, one is alive to-day, since February 23, and in excellent condition. One died on the tenth day after operation, having refused food; autopsy, probable slow necrosis of stomach. One died, also on the tenth day after operation, of distemper, this crux of surgical research work in dogs, with a well-functionating anastomosis.

To these six operations must be added two other cases in which the same kind of anastomosis was done, once in a resection of the cardia, and once in a resection of that portion of the œsophagus lying behind the aortic arch. In the case of resection of the cardia including about one-third of the cardiac end of the stomach, the dog recovered nicely from the operation, but died on the fourth day thereafter, having vomited all nourishment given. Autopsy showed the implanted lower end of the œsophagus inverted back into the tube, its muscular covering having become completely agglutinated

(Fig. 23). In this case a goodly portion of the œsophagus having been available for anastomosis, at least three-fourths of an inch of same had been implanted into the stomach. It is assumed that during one or more vomiting spells the implanted portion was pushed up into the lumen and became quickly adherent. A good lesson for the operator: First, not to allow the implanted portion to be too long; second, to introduce a bougie, if vomiting persists; third, to make use of Levene's rapidly absorbable catgut and allow the implanted portion to remain closed during the first few days after the operation, rather than to insist on making patent at once the lower cut end of the œsophagus by removing the bow-knot which closes it, before the last anterior suture is tied.

The dog in whom the part under the aortic arch had been resected, died of shock within 12 hours after operation. In this case almost the entire stomach had been pulled up into the thorax and anastomosis was then done in front of the aorta.

In addition to these eight operations which were done with the help of needle and thread I did two other cases of implantation of the divided œsophagus into the stomach on a somewhat different plan. In one an extramucous purse-string suture of silk had been placed around the implanted lower end of the divided œsophagus. This dog died on the sixth day after the operation, of distemper and gastric hemorrhage, the latter being due to a lead ball which had been attached to the cut end of the œsophagus and introduced into the stomach in order to pull it downward by its weight.

The second dog, which had made a perfect operative recovery, died suddenly on the twenty-third day after operation. At the time of this operation the method, described above, had not yet been thoroughly developed; the posterior approximating sutures, uniting the œsophageal stump to the stomach, had not been added as yet. Autopsy (Dr. F. C. Wood) showed a diaphragmatic hernia which had produced a kink in the duodenum; the stomach was filled with food. Direct mechanical pressure of the distended stomach upon the heart seemed to have been the immediate cause of death.

In view of the results obtained, the operation above de-

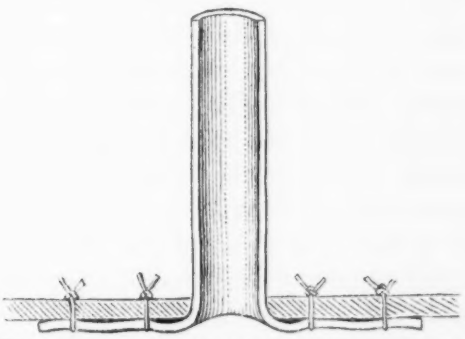
scribed has to be considered a proper surgical procedure, technically. As to its functional results, ways will have to be found to avoid a stricture.

The latter must be due to one of the following causes: (1) To dividing the œsophagus with Paquelin's cautery, knowing that burnt wounds have a greater tendency to contraction than cut wounds. (2) To our dividing the œsophagus perpendicularly to its longitudinal axis, which also favors the formation of a stricture. (3) To contraction of the stomach wound around the implanted œsophagus.

FIG. 24.

Oblique division of œsophagus, to avoid stricture.

FIG. 25.



Œsophagus divided lengthwise, mattress sutures connecting its flaps with the cauterized gastric mucosa.

To avoid possibility No. 1, scissors were in later cases used instead of Paquelin's cautery in dividing the œsophagus. To overcome the second possibility, the œsophagus might be cut obliquely instead of transversely (Fig. 24), provided sufficient material be available at the proximal end (not yet tried), or, the lower end could be divided lengthwise and either half stitched to the gastric mucosa by means of a mattress suture or sutures, after the mucosa had been cauterized with Paquelin (Fig. 25).

This latter method has been tried, but the dog died of leakage and infectious pleurisy on the fourth day after operation (faulty technic, see above).

In order to simplify the operation, a purse-string suture, avoiding the gastric mucosa, of course, might be used, as done

in the first dog operated upon with needle and thread. Post-mortem showed in that case, that the purse-string suture had slightly kinked the lower end of the œsophagus, it evidently having been drawn too tight. It is intended to try this method again and close the purse-string suture around a short cylindrical tube of magnesium, around which the lower end of the œsophagus is fastened by two circular ligatures. In this way the œsophagus cannot become strangulated by the purse-string suture and the magnesium will be absorbed. A few sutures may further secure the œsophagus to the stomach, as it is often done when using Murphy's button in abdominal surgery.

To avoid the third possibility, the gastric wall was not merely incised, but the seromuscular coat, according to thickness, either excised in an oval-shaped manner with the axis running parallel to the transverse diameter of the body, or pushed back with the handle of the knife or with Cooper's scissors and either border stitched on to the œsophagus, the gastric mucosa alone being last incised with a straight cut (see above).

We must try to render the operation less serious. Perhaps it may appear advisable in weak patients, to do a two-stage operation. For instance:

First stage: Thoracotomy in seventh or eighth intercostal space; transposition of part of stomach into thoracic cavity; loose fixation suture of stomach around rib, in order to keep the gastric wall on the stretch. Closure of thoracic wound. Jejunostomy for forced feeding. This latter operation could also be done prior to attacking the œsophagus. As the fistula is water-tight, the tube can be safely extracted for the time of operating on the thorax, the fistula can be packed with gauze and the external opening covered with zinc plaster. Leakage will not occur and infection be avoided.

Second stage, two to three weeks later, incision is made in the fifth intercostal space and œsophagogastrostomy done after resection of the growth.

We are justified in expecting this second act of the operation to be less dangerous as far as infection is concerned, than the first one. We know from our intra-abdominal work,

that serous membranes, once opened and handled, absorb less and show greater resistance to infection than at the time of the primary interference.

Sauerbruch advises the use of Murphy's button for the anastomosis. I have tried this 8 times. One of the dogs was lost in consequence of pressure necrosis of the œsophagus by the border of the button about one-half of an inch above the anastomosis. After this experience I discarded the button, reserving its use for emergency cases, and have since then worked only with needle and thread.

At the Research Laboratory of the Medical Department of Columbia University of New York a special kind of small button has been brought out for this kind of work. Perhaps this would answer better than Murphy's cholecystenterostomy button which I tried. But the fact remains that in these cases, with a portion of the stomach pulled into the thoracic cavity, the button has to wander through the *entire* gastro-intestinal tract, inclusive of pylorus, duodenum and plica duodenojejunalis. The chances of its being retained are, therefore, much greater than in cases of gastroenterostomy or lateral intestinal anastomosis. There can be no question that, if œsophagogastrostomy *can* be safely accomplished with needle and thread, this method deserves the preference.

Of course, many roads lead to Rome. Nobody can be more fully aware than myself of the fact that the procedure just described is but one method that promises success. No doubt the combined work of many surgeons along the same lines and toward the same end will soon show us the right way; and, surely, such united effort is well worth undertaking. Are not thousands of patients dying every year of œsophageal carcinoma without our being able to offer them even a ray of hope from any kind of treatment. Ways and means *must* be found that will enable us to safely attack also this type of malignant growth if seen at an early stage of its development. We *must* succeed also in the human being in properly anastomosing the proximal end of the œsophagus to the stomach, so that the patient can again eat and drink in the normal manner.

CHRONIC INTESTINAL STASIS.*

BY W. ARBUTHNOT LANE, M.S.(Lond), F.R.C.S.(Eng.),

OF LONDON,

Surgeon to Guy's Hospital; Senior Surgeon to Hospital for Sick Children, Great Ormond Street.

CHRONIC intestinal stasis comprises the conditions arising in consequence of the progressive development of an imperfect or delayed functioning of the gastro-intestinal tract. While constipation is the most frequent objective evidence of unsatisfactory drainage associated with chronic intestinal stasis, it happens not uncommonly that there may be a daily evacuation, though in some cases the motions may be abnormally frequent and loose. Therefore, the character and frequency of the evacuations are by no means constant in this condition. I will endeavor to describe what I consider to be its pathology.

1. In the first place, there is the dilatation and extension of the cæcum into the true pelvis, associated with the development of retaining bands or mesenteries between its outer aspect and the adjacent peritoneum lining the abdominal wall. The cæcum may become so distended that after occupying the true pelvis it ascends upwards from it.

2. There is the fixation of the appendix by retaining bands continuous with those holding up the cæcum and securing the appendix usually about its centre sometimes by separate bands and at other times by a band blended with the normal mesentery of the appendix. This band is continued by the proximal portion of the appendix, and forms together with it a retaining support helping to hold up the cæcum and oppose its descent from its normal position.

The drag exerted upon the cæcum, upon the proximal part of the appendix and upon its retaining band of peritoneum, produces a kinking of the lumen of the appendix at its point of fixation, since the distal portion of this structure is neces-

* Read before the American Surgical Association, June 3, 1909.

sarily tilted abruptly upon its proximal segment. The degree and chronicity of this occlusion produce varying results, all of which are grouped under the heading of "appendicitis." The point of the abdominal wall to which the appendix becomes secured varies within wide limits, but it is usually anchored to the iliac fossa. If, however, it is fixed to the posterior wall or floor of the true pelvis, the appendix in the female finds itself in a dangerous proximity to the right ovary, which is affected by any inflammatory change in the appendix, while during menstruation the engorgement of the ovary and adjacent structures accentuates any trouble in the appendix.

Though surgeons refuse to recognize the causation of these bands obstructing the appendix, they know that adhesions exist about it very constantly, and they are always very ready to avail themselves of these adhesions as an excuse for removing the appendix when they have opened the abdomen on a wrong diagnosis of disease in some other organ, such as stone in the gall-bladder, duodenal ulcer, stone in the kidney or ureter, etc. At the operation, when the incorrectness of the diagnosis is plain to all they satisfy their own conscience, the medical attendant, the patient and friends, by removing an appendix anchored in the manner I have described.

3. The ascending colon is anchored to the peritoneum lining the abdominal wall external to it by similar bands while the hepatic flexure is drawn upward and outward to an abnormally high level by the presence of bands of peritoneum of considerable density.

4. The transverse colon forms a loop whose convexity reaches, in some cases, into the pelvis, where it struggles with the cæcum for priority of occupation.

Bands of peritoneum bind the convexity of the transverse colon to the adjacent ascending and descending segments of the colon. Above, these viscera are bound directly together by newly developed adhesions, but below they are connected by an acquired mesentery.

5. The splenic flexure and descending colon present changes similar to those described on the right side.

In the large bowel, generally, the strain exerted by restraining bands may so control it as to reduce its lumen very materially at one or more points.

6. The changes in the sigmoid are perhaps the most striking and obvious. They arise in precisely the same manner as those already described. Nature makes an effort to convert the mobile loop, which would attempt to occupy the pelvis, into a narrow fixed straight tube connecting the descending colon and rectum.

This is effected by the development of little bands which pick up the outer aspect of the mesosigmoid and secure it to the adjacent peritoneum. This process continues till a proportion of the outer wall of the sigmoid itself is secured to the iliac fossa and the tube is rendered fixed and straight, all evidence of the original loop having disappeared. This ideal condition does not always exist since the bulk of the mesentery may not have been grasped securely by the newly developed adhesions before the ends of the loop have been secured and approximated by them. Consequently, a very considerable dilatation of the sigmoid results, and when it is completely obstructed it is called a volvulus.

The fixation of the sigmoid by these acquired adhesions may be irregular, and obstruction may occur at one or more points in its length.

Unfortunately for the left ovary, it lies in immediate relationship with the mesosigmoid, and it very frequently indeed becomes involved and fixed in the acquired adhesions. In some cases it appears as if the ovary is merely anchored to the contracting mesosigmoid by adhesions, while in others the ovary may be completely surrounded by and included in the altered mesosigmoid.

7. The fixation of the left ovary is very detrimental to that structure since it is followed sooner or later by a cystic change in that organ. In some cases the ovary may be infected with a chronic inflammation, or suppuration may result in it, necessitating its removal. Very rarely the sigmoid may be so much involved by the process that it may be necessary to resect a portion of it also.

The cystic ovary, completely surrounded by the adhesions, may, after a time, again become mobile in a cavity developed in them, and later may escape from it. It then ceases to have any apparent connection with the adhesions in which it was embedded except in so far as the association of an anchored sigmoid and a cystic ovary is observed to exist.

8. The ileum is very thin walled and flaccid. If its termination is drawn upward so as to expose the under surface of its mesentery the peritoneum forming its posterior surface is picked up in puckers, precisely like the mesosigmoid but not so effectually. This is clearly with the object of helping to support the loaded cæcum and oppose its displacement.

9. The stomach is dragged downward by the pull exerted upon its convexity by the depressed transverse colon, while the pylorus and first portion of the duodenum are bound to the under surface of the liver and often to the cystic duct and gall-bladder. The stomach is dilated, apparently because of the kink effected at the exit by the downward drag on the convexity of the stomach and the resistance offered by the adhesions binding the pylorus and duodenum to the liver.

Owing to the very different construction and mechanics of the abdomen and of the viscera in the sexes, the mode of anchoring of the pylorus and duodenum differs somewhat. I believe that this variation is responsible for the greater frequency of duodenal ulcer in the male and of gastric ulcer in the female.

The posterior surface of the stomach is not infrequently adherent to the peritoneum covering the pancreas, etc.

10. The gall-bladder is generally full of bile, and gall-stones are not infrequently present. The development of gall-stones may be consequent on the stagnation of bile in the gall-bladder whose evacuation is impaired by the drag upon it or its duct by the anchored duodenum and pylorus and by the prolapse of the liver itself. Women being much more frequently affected by intestinal stasis than men, suffer more often from gall-stones. It is a noteworthy fact, that while

gall-stones do not form in cases of intestinal stasis in which loss of flesh results at an early period of life from toxic absorption, they do so very readily in stout women, in whom intestinal stasis develops in a marked degree comparatively late in life.

11. The breasts show changes which vary from a recurring mastitis affecting the upper and outer segments of the breasts, and especially of the left, to a definite cystic degeneration involving the whole of both breasts. These degenerated breasts are very susceptible to the development of malignant disease.

12. The kidneys are mobile.

13. There is very little fat.

14. The skin is stained and inelastic.

15. Respiration is chiefly diaphragmatic.

16. The circulation is bad, as evidenced by the coldness of the extremities.

17. The muscles are very friable and small in bulk.

Symptoms.—The symptoms produced by this condition of things are due in part to the interference in the normal functioning, and are expressed by pain, and in part to the absorption of poisonous material, and are evidenced as toxæmia.

While toxic symptoms may exist without pain, pain has always associated with it definite evidence of auto-intoxication. I would just mention that many of the objective evidences of auto-intoxication, such as pigmentation of the skin and bad smelling perspiration, are much influenced by the color of the hair. In light-haired people a very advanced condition of poisoning may exist without the presence of these symptoms, while in dark-haired people these evidences appear at an early period.

Pain is due apparently to the distention of a portion of the bowel with fecal contents and their gaseous products, or by the passage of fecal material through the bowel. For instance, the distention of the cæcum is a frequent and distressing symptom.

Pain about the hepatic and splenic flexures, both in front

and behind, results from the obstruction which exists at those points and from the drag or strain upon the retaining bands by the loaded bowel in the erect posture of the trunk.

Pain in the sigmoid segment may be due to the difficulty in forcing the contents through a fixed straight tube of diminished calibre, length, and elasticity, whose mucous membrane may be gorged, inflamed or even ulcerated, or to the distention of a loop or loops placed at a mechanical disadvantage by irregular anchoring by adhesions. Pain also results from the distention of the stomach, and also of the small bowel because of its delayed functioning.

Pain in the fixed left ovary is frequently a distressing symptom, especially at the periods. The fixation of this irritated organ renders it very tender on pressure, especially if examined bimanually, since it cannot readily avoid the pressure of the fingers as a mobile ovary does. Apart from this, there are the mechanical symptoms which ensue from the progressive development of the cystic condition of the ovary which is now found to be more frequently malignant in structure than was supposed.

Degenerative cystic changes in the breast are very commonly present in a varying degree in certain cases of chronic intestinal stasis. This change is usually first observed in the upper and outer segment of the left breast, and later in the corresponding area of the right breast.

In the young unmarried woman a chronic mastitis which is accentuated at the periods is a very common symptom. It affects the same areas of the breasts as does the cystic change which appears later. In a number of patients on whom I have operated for chronic intestinal stasis, one or both breasts had been removed for cystic degeneration. This condition has been called Schimmelbusch's disease. I have been much struck by the fact that these degenerative conditions do not arise in the breasts of women having regular intercourse, however toxic they may be, while they develop very rapidly on its cessation. How far the mechanical impairment of the sexual apparatus here referred to is responsible for the loss

of sexual appetite, which is a very marked feature in these women, and how far it is consequent on the associated toxæmia, is a matter of question. In any case it is much influenced for good by the cessation of the auto-intoxication following on some satisfactory treatment of the defective intestinal drainage. It is not improbable that the more frequent presence of cystic change in the left breast results from the fact that the left ovary is damaged and rendered cystic very much more often than the right, owing to its fixation by or inclusion in the bands which obliterate the mesosigmoid and shorten and straighten the sigmoid.

The pain due to movable kidneys, gall-stones, gastric and duodenal ulcers, pancreatitis, renal conditions due to the narrowing of the right ureter by the band retaining the appendix or by suppuration about the appendix, uterine versions and flexions, and to many other conditions which I believe are all effects of chronic intestinal stasis, is fairly characteristic. It is difficult to separate abruptly the symptoms that are brought about mechanically by intestinal stasis from those which result from the consequent auto-intoxication, since many are due to both.

Here I would like to call attention particularly to the work of Dr. Victor Vaughan and Miss Wheeler "On the Effects of Egg White and Its Split Products on Animals," and the work of Dr. Turck "On Experimental Studies on Round Ulcer of the Stomach and Duodenum." I can do no more than refer to them here, but their importance in reference to intestinal stasis is obviously very great indeed.

The chief toxic symptoms are: Headache, a feeling of mental and physical lassitude, an inability to perform the ordinary duties of life, mental misery and distress, nerve symptoms (as migraine, etc.), which are comprised usually under the term of biliousness, and a want of control over the temper which renders these patients unpleasant and unhappy companions.

The symptoms for which the patient seeks relief from the surgeon vary materially with the position and occupation

of the sufferer. While the unfortunate governess or domestic servant will struggle on until complete physical disability renders her incapable of performing her duties, the woman who has not to earn her living calls attention rather to the mental distress from which she suffers. For this reason the patient in good circumstances receives attention at a much earlier stage in the disease than does the poor worker and either requires a less extensive operation or benefits much more from a serious one. Too frequently the poorer patient has reached a stage in which operative procedures, however extensive, afford only a temporary benefit, since the distention of the small intestine having reached a certain limit is liable to return and progress after an interval, and with this distention is associated pain for which very little relief can be afforded.

Of the many cases of chronic intestinal stasis in private practice which called for operative interference, in nine only have I removed the large bowel. Of these one died, and that accidentally from the bursting of a small deep-seated stitch abscess into the general cavity. Of the larger number of private cases in which division of the ileum and its junction with the large bowel was effected, there was no death from the operation. One of these patients died from acute obstruction six months after the operation. The cases in private practice in which simple division of constricting bands or the establishment of a junction between the occluded ileum and the sigmoid or rectum are sufficient, are much more commonly met with than in hospital practice.

Auto-intoxication reduces the resisting power of the individual to the entry of organisms of various sorts, and facilitates their obtaining a foothold in some of the tissues of the body. I will call attention to only one organism—namely, the tubercle bacillus, since it illustrates very well this depreciation in the vitality of the tissues. The examination of a large number of dark-haired children affected with chronic tubercular disease of joints will show the presence in them of unmistakable signs of auto-intoxication.

The examination of a number of girls suffering from lateral curvature or the fixation of the asymmetrical position of rest will afford striking evidence of the effect of the toxin in depreciating the respiratory capacity and energy of the individual, and will show them to be characteristically toxic. In them, as in the tubercular cases alluded to, thoracic respiration is more or less completely in abeyance.

TREATMENT.

If I have done no more than to impress on the reader the importance of regarding chronic intestinal stasis as a very serious condition, and one whose capacity for harm is great and far-reaching in its results, I shall feel that my efforts have not been without result. We must acquire as thorough a knowledge as possible of the causation and pathology of delayed intestinal drainage, and so endeavor to render our treatment of its several stages as scientific as possible.

I do not propose to discuss the medical treatment here, but will assume that the condition has developed to a degree that such treatment is obviously inefficacious to give the relief required. In other words, a stage has been reached in which, owing to the delay in evacuating its contents, the large bowel has not only ceased to perform a useful function but has become such a source of danger that its removal from the drainage scheme will be of great service to the body.

It depends on the development of the condition as to whether it is sufficient to separate and destroy constricting bands, or to divide the ileum and to connect it with the sigmoid or rectum, or whether it is necessary to remove the large bowel proximal to the junction. While in an early stage, and especially in the male subject, the obstruction at the hepatic or splenic flexures or at the sigmoid may be relieved by the division of bands producing constriction, in a late stage when the small intestine has undergone extreme changes the removal of the whole of the large bowel proximal to a junction between the small intestine and the sigmoid affords only a temporary alleviation of symptoms.

The most favorable cases for operation are those in which the symptoms are of a toxic rather than of a painful nature. In such, the division of the ileum and its junction with the lower part of the large bowel gives complete relief to the symptoms, and the consequent physical and mental improvement is extraordinary. When painful symptoms are much in evidence the large bowel should be removed. The risk entailed by operation can be reduced very materially by first relieving the toxic symptoms by connecting the divided ileum with the sigmoid or rectum, and later, when the general condition of the patient has improved in consequence of this procedure, the large bowel can be excised if the symptoms demand it. I do not pretend that removal of the large bowel is not a very serious operation in certain circumstances. Indeed, in many of these patients any serious operation must be regarded as being dangerous to life, the danger varying chiefly with the degree of toxicity. I may say that in these and similar cases the risk can be very greatly diminished by the subcutaneous injection of a large quantity of normal saline solution immediately before the operation. By this means the patient appears to suffer a minimum of shock from the extensive operative procedure, and vomiting either does not follow it or, should it do so, is trivial in character. In these cases the absence of vomiting is a matter of very great importance. It was very frequent and severe after my earlier excisions of the large intestine, and was the cause of more than one fatal result. Besides the distress and depressing influence it exerted on the patient, the constantly recurring strain on a long wound was very liable to render it insecure or to determine the development of a septic infection in it which would probably not have occurred had the recently incised structures been kept at rest. The risk of an infection starting in the peritoneal cavity appears to be very small. The mode in which the subcutaneous transfusion of normal saline employed immediately before the operation acts, has been very clearly demonstrated by Dr. Crile's most interesting and valuable researches on the production of shock, of which America must be very justly proud.

SURGERY OF THE LARGE INTESTINE.*

WITH A REVIEW OF ONE HUNDRED RESECTIONS.

BY WILLIAM J. MAYO, M.D.,

OF ROCHESTER, MINNESOTA,

Surgeon to St. Mary's Hospital.

I. GENERAL CONSIDERATIONS.

FROM the foregut we get the stomach and duodenum to a point below the common duct, the liver and the pancreas. All of these organs derive their nourishment from the cœliac axis and are concerned in the preparation of food for absorption but do not themselves absorb. Morphologically the small intestine begins at the pylorus, functionally at a point beyond the common duct.

The derivatives of the midgut are concerned in absorption and assimilation, and extend from the middle of the duodenum to the splenic flexure of the colon, where the hindgut begins and corresponds to the area of distribution of the superior mesenteric artery.

Ninety per cent. of the solids are picked up in the jejunum and ileum, and about half of the fluids are absorbed there. Ten per cent. of the solids and the balance of the fluids are absorbed in the large intestine proximal to the splenic flexure, largely in the cæcum. A physiological contraction between the cæcum and ascending colon at the situation of the cæcocolic sphincter in certain lower animals, holds the material between this point and the ileocæcal valves during absorption, and accounts for the localized cæcal distention with gas and fluids noticeable on palpation in diarrhœal disturbances. The fluids ingested, and also those secreted by the liver and pancreas, are used to keep the ingesta thin and in close contact with the valvulæ conniventes and to mechanically float the residue finally into the cæcum, where fluidity is no longer necessary

* Read before the American Surgical Association, June 5, 1909.

and where it is re-absorbed. The chemical change from alkalinity to acidity of the material upon entering the large intestine, a change which is connected with bacterial action, causes the formation of gases which play an important part in the further progress of the residue in the large intestine.

The differentiation between the midgut and the hindgut is not so well marked as between the foregut and the midgut (Young-Robinson). The hindgut gives rise to the descending colon, the sigmoid and rectum to the anal canal, and is supplied by the inferior mesenteric artery. Excepting during defecation the normal intestinal movement in this portion of the intestinal tract is antiperistaltic, so that fluids introduced into the rectum, as in Murphy's proctoclysis, are carried backward for absorption above the splenic flexure, only a small amount being taken up by the derivatives of the hindgut, although many drugs and chemicals may be absorbed here. Bond has shown that solid particles when placed in the rectum are also carried upward by what he calls "reverse mucous currents." The descending colon, which marks the beginning of the hindgut, is usually found empty and acts as a passageway between the physiologically active midgut and the passive sigmoid. The function of the latter is to act as a fecal container, which its trap-like curves enable it to do.

At the juncture of the fundus and the antrum of the stomach there is a physiological muscular activity which takes the place of the antral sphincter in certain of the lower animals. From this point to the descending colon the control depends upon internal secretions, and the sympathetic ganglia, and, while influenced by Auerbach's and Meissner's plexuses, this control is largely independent of the cerebrospinal nervous system, as the maintenance of the body is a primitive function and existed before the development of the cerebrospinal system.

In the eleventh week of fetal existence the large intestine shows the cæcal bud beginning to contract at its extremity, the site of the future appendix. The intestinal tube, which has been straight, has developed the U-shaped loop connected with

the yolk-sac by the vitelline duct close to its middle. The remains of this duct may give rise to a Meckel's diverticulum which, if present, is usually to be found in the lower ileum within two or three feet of the ileocæcal valve. At the third month the entire large intestine is still to the left of the median line; but by the fourth month the head of the colon has rotated across the superior mesenteric artery and duodenum, and lies underneath the liver, to reach its normal situation soon after birth. During this rotation the contraction of the large herbivorous-like cæcum into the carnivorous type is rapid, and the appendix is one result. Failure of complete rotation of the large intestine accounts for those cases of appendicitis on the left side or under the liver.

According to Ribbert, at birth the appendix is one-tenth the length of the large intestine, and in the adult, one-twentieth. Birmingham gives the length as one-sixteenth at birth and one-twentieth in the adult. Up to six years of age the normal appendix always contains a lumen, but after this time there often begins an involution with obliteration of the lumen from the tip toward the base. Ribbert states that in adults thirty-five years of age 25 per cent. of appendices are completely obliterated, and at seventy years of age one-half or more are obliterated. Birmingham's investigations do not bear out Ribbert's claims. He states that only 3 to 4 per cent. of adults have completely obliterated appendices, but that 25 per cent. of young adults and 50 per cent. at the age of fifty show partial obliteration. Our observations agree with those made by Birmingham.

Irregular obliteration, producing dams and strictures along the lumen of the appendix, is undoubtedly an important factor in the sedimentation which produces those fecal concretions which play so important a rôle in the causation of appendicitis.

Berry believes that the appendix is an important organ containing lymphoid structures like Peyer's patches, and that the tendency to obliteration seen in adults is the normal atrophy of lymph organs which occurs after the growing period of the individual has been accomplished.

Macewen and Keetley deprecate the present tendency to remove the appendix unless absolutely necessary to save life, believing that its removal tends to cause constipation and other colonic diseases. Keetley goes so far as to advocate the practice of opening up the appendix, removing stones if they are present, evacuating abscesses and finally burying the remnant of the organ in the abdominal wall to prevent future chance of peritonitis, thinking thus not only to maintain the function of the appendix but to enable its later use for appendicostomy should colonic inflammation or obstinate constipation supervene. I am unable to concur in this opinion as I cannot believe that an organ of such exceptional value as they state the appendix to be would so early become atrophied were it endowed with so great a function. At best, the saving of a functionally useless organ which is so diseased as to contain abscesses, stones, etc., is not in harmony with modern views. We are only just beginning to recognize that serious functional digestive disturbances, such as pyloric spasm (appendiceal dyspepsia), colitis, etc., are often produced by a chronically diseased appendix.

It is evident that constipation most directly concerns the sigmoid and that its function as a fecal container is a comparatively late evolution. This is shown by the great variations in its length, size and shape (Finney). The fact that the sigmoid, like the fundus of the stomach, is more or less under conscious control of the cerebrospinal nervous system, also indicates a late development.

In the ANNALS OF SURGERY, December, 1900, the writer calls attention to certain varieties of constipation having primary origin in the small intestine due to congenital or acquired narrowing at the ileocæcal orifice, and reported several cases relieved by operation. Further experience has strengthened the opinion therein expressed. An obstinate constipation may depend upon too prolonged retention of the ingesta in the small intestine, interfering with proper chemical changes.

The head of the colon is extensively sacculated and of large capacity, but gradually diminishes in size, and in the descend-

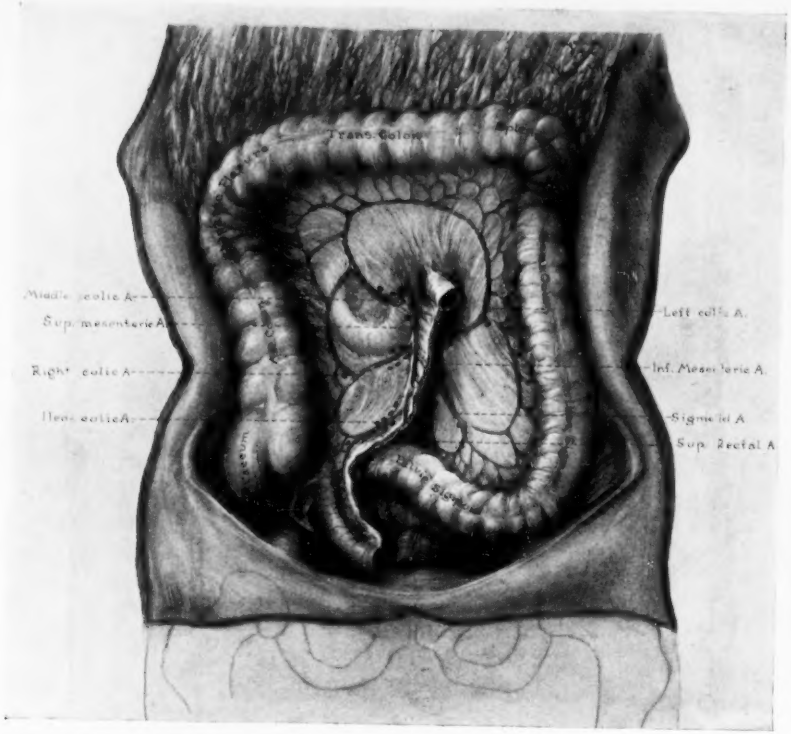
ing colon and sigmoid the sacculations are primitive (Fig. 1). The diameter of the sigmoid is less than one-half that of the cæcum. The longitudinal bands of muscle have, however, gradually increased in width and strength until at the juncture of the sigmoid and rectum they practically surround the intestine and a complete investment extends down about the rectum, showing the increased muscular pressure which is necessary to propel non-liquid contents. Defecation is accomplished largely by siphonage which usually completely empties the sigmoid. A hardened mass of fæces forms the apex of the stool-mass which is set in motion by the abdominal muscles compressing the intestinal gases. The normal rectum in the quiescent state contains fæces only temporarily, as is shown by the examination of a large number of males for the army service. In the female, and sometimes in the male, an acquired tolerance may be found, and the rectum to contain chronically more or less hardened fæces.

Treves in 1885 and Jonnesco in 1889 called attention to the inaccuracy of the anatomical description of the lowest sigmoid and first portion of the rectum, showing correctly, as I believe, that the so-called "first portion of the rectum" should be considered the terminal portion of the sigmoid down to the ending of the mesenteric attachment at about the third sacral vertebra. Here the rectum begins and extends to the anal canal which lies below the levator-ani muscle. Embryologically, the true rectum has its origin from the highly differentiated lower part of the hindgut called the *cloaca,* which forms the bladder and rectum. This primitive association is of importance in the study of malignant disease.

Symington has made careful studies of the lower rectum and points out that the anal canal, about one to one and one-fourth inches in length, is completely invested with muscle and has its origin in the proctodeum, and for this reason in cancer of this locality the inguinal glands are liable to be involved as well as the perirectal.

British anatomists divide the sigmoid into two portions. First, the iliac, 5 to 6 inches in length, extending from the

FIG. 1.



Anatomy of the large intestine. Note the relation of glands and blood-vessels.

FIG. 2

Mobilization of cæcum and ascending colon. Note duodenum and ureter exposed.

descending colon to brim of the true pelvis and having, if any, a very limited mesentery. Second, the pelvic portion, which averages 16 to 18 inches in length, has a long mesentery and loops across the median line. Cunningham states that in 92 per cent. of subjects the pelvic sigmoid lies in the true pelvis after death. There is no question but that this description is more accurate and is based on a better understanding of the anatomy than that which is ordinarily accepted in this country (Fig. 1).

The large intestine is from 5 to 5½ feet in length, and is about one-fifth of the intestinal tract.

The cæcum and appendix are ordinarily completely invested by peritoneum. The transverse colon, which, including the hepatic and splenic flexure, is about 20 inches in length, and the pelvic sigmoid, have a well developed mesentery. The ascending and descending colon, and the iliac sigmoid are more or less closely attached to the posteriolateral parietes.

The ascending colon, averaging from 7 to 8 inches in length, has an insecure attachment to the posterior muscles in its retroperitoneal extent, and upon this the weight of the ileocæcal coil is suspended. The result of the traction tends to loosen the ascending colon from its bed, leaving a pouch into which the right kidney often prolapses, the descent of the kidney being aided by the attachment of the colon to Garroto's capsule and the so-called "nephrocolic ligament." On the left side this does not obtain, as the descending colon and the iliac sigmoid is closely attached in its retroperitoneal extent and gives a weight-bearing space of from 12 to 14 inches.

Under normal conditions, as shown by Monks, the lowest ileum lies in the pelvis, the last 8 inches ascending from the pelvis to the cæcum, and its terminal 2 inches is closely attached on the cæcal side (Fig. 4). This attachment takes place early in fetal existence so that, as a rule, the base of the appendix will be found within three-fourths of an inch of the ileocæcal orifice. The lop-sided appearance of the cæcum is due to the development of sacculations, which more easily occur on the free side. The terminal 6 inches of the ileum has the same

blood supply and lymph drainage as the cæcum, through the ileocæcal vessels. For this reason, in all cases of malignant diseases of the cæcum, the appendix and terminal 6 inches of the ileum must be removed. Occasionally a lymph gland will lie in the meso-appendix, and if so, lymph drainage from the right ovary and tube may find its way into it through Cleido's ligament.

The ascending colon is supplied by the right colic artery, a branch of the superior mesenteric, anastomosing below with the ileocolic and above with the branches of the middle colic. The lymphatic drainage extends into the lymphatic glands at the base of the right colic artery and also in the ileocolic group. In carcinoma of the ascending colon it is necessary to remove the cæcum and the terminal 6 inches of the ileum in order to secure the tributary lymph nodes.

The middle colic artery comes from the superior mesenteric just below the pancreas, passing almost directly downward into the transverse mesocolon where it gives off large arterial arches to the right and left. The main arch passes to the left to anastomose with the left colic which arises from the inferior mesenteric. The middle colic is the main source of the blood supply of the transverse colon, including the hepatic and splenic flexures, and while the anastomoses with the right and left colic suffice for the hepatic and splenic flexures respectively, Krönlein points out that in four cases out of five the transverse colon itself will not be nourished in its whole extent if the middle colic vessels are ligated. Injury to this vessel sometimes happens in resection of the stomach for cancer and may cause gangrene of the transverse colon.

The splenic flexure of the colon has a reduplication of the peritoneum derived embryologically from the omentum, which is sufficiently defined to be called the "costocolic ligament." The costocolic ligament has no large blood vessels, and by division of it the splenic flexure is loosened from its deep situation and can be readily brought to the surface. The hepatic flexure has not this source of retention, therefore it is easily accessible, although there is often an extension to it of the duodenohepatic ligament.

The lymph drainage of the hepatic and splenic flexures as well as the transverse colon follows into the root of the transverse mesocolon. The lymph nodes are in close communication with the deep lymph-chain along the aorta and about the head of the pancreas, and in malignant disease the accurate removal of the lymphatic-bearing mesentery is correspondingly difficult.

The left colic artery supplies the descending colon, but its anastomosis with the middle colic above and the sigmoid below makes extensive resections in this vicinity relatively safe. Fortunately the lymph supply diminishes rapidly from the ileocæcal coil, and has reached its lowest ebb in the sigmoid. The very nature of the function of the colon, containing as it does virulent bacteria and toxic poisons, makes this lymph sparseness a necessity. Butlin has shown that over 60 per cent. of the deaths from cancer of the colon take place from obstruction or other causes before there is general metastasis, and many times, if enlarged glands are present, they will be found inflammatory.

The tendency of the lymph drainage of the descending colon is towards the transverse mesocolon following the middle colic tributaries.

The sigmoid derives its blood supply from the sigmoid artery, a branch of the inferior mesenteric, and anastomoses freely above with the left colic, and below with the superior rectal. The lymph drainage follows the vessels, and Moynihan points out that the highest lymph node lies at the origin of the inferior mesenteric vessel. It would appear necessary, therefore, in operating for carcinoma of the sigmoid to resect extensively so as to remove the Moynihan gland with the mesentery, although this may necessitate destruction of the inferior mesenteric vessel with its tributary intestine.

The terminal portion of the sigmoid, the so-called "first portion of the rectum," is supplied by the superior rectal artery which communicates freely with the middle hæmorrhoidal arteries. The lymph drainage follows the superior rectal vessel which is the direct continuation of the inferior mesenteric, and

to secure the highest lymph node at the origin of the inferior mesenteric, it may become necessary to ligate this vessel and remove the devitalized colon possibly almost to the splenic flexure.

In estimating the feasibility of removing malignant disease of the large intestine, the examination of the liver for embolic carcinoma should not be forgotten. In our experience, hepatic secondaries have been a larger cause of contra-indication to radical operation in mechanically removable tumors than inoperable glandular metastasis.

By rectal touch the peritoneal sac can be felt anteriorly at the rectovesical fold. Carcinoma of any viscus in the peritoneal cavity may permit detachment of carcinoma cells which gravitate into the cul-de-sac and graft upon the adjacent sigmoid, giving rise to the characteristic nodules which indicate the nature of the primary and possibly unlocated disease.

There are a number of fossæ in connection with the large intestine which may occasionally have surgical importance. They are due to faulty blending of the peritoneum with the large intestine, giving rise to small pockets extending up behind the bowel. There are several of these recesses about the cæcum in which the appendix is occasionally found.

This faulty blending of the large intestine with the peritoneum is well shown on the right side, the peritoneal sac being well developed before the cæcum and ascending colon reaches its normal position, which does not occur until at or near birth. The result is that the attachment of the head of the colon to the parietal peritoneum is of a veil-like nature, resembling adhesions.

The entire large intestine is covered with a greater or less number of appendices epiploicæ, and in the obese these epiploic tags may reach considerable size. As a result of injury or local peritonitis they sometimes become attached to the parietes or neighboring structures, causing fixation of the intestine, or a band may be the cause of obstruction. Torsion may occur, with necrosis. We have met with two examples of this condition.

II.—SURGICAL CONSIDERATIONS.

Preparation.—Perhaps no factor has proved of greater importance to the human race than the sterilization of food by cooking. While the secretions of the stomach itself outside of the stomach do not have marked bactericidal properties, it should not be forgotten that bacteria are vegetable organisms, and that the digestive power of the stomach acts to destroy the bulk of the micro-organisms introduced so that the contents of the duodenum and upper jejunum, as shown by Adami and Cushing, are relatively sterile. This is shown clinically by the higher percentage of recoveries from perforations, gunshot injuries, etc., in the stomach, duodenum and jejunum, as contrasted with the ileum and colon.

The ileum contains a rapidly increasing number of bacteria and the lower two feet teem with virulent organisms. In the colon bacterial growth is marked and adds materially to the bulk of the stool. Hochenegg points out that liquid stool contains very active bacteria, especially the colon type, and therefore catharsis should not immediately precede operation upon the colon. The bowel should be thoroughly emptied 48 hours preceding operation, giving at least 24 hours for the intestine to become quiet. This is also advisable because of the greater ease of dealing mechanically with the bowel if its contents are semi-solid rather than fluid.

Obstruction.—The most important feature of surgery of the large intestine, taken as a whole, is the question of obstruction. The mortality of necessary operations can be closely measured by the degree and acuteness of this condition.

It happens, unfortunately, that in some cases of tumor the first important symptom is an attack of acute obstruction. This is particularly true of tumors of the sigmoid where the calibre of the intestine is more limited and the contents of a more solid nature. The obstruction interferes with the vitality of the distended intestine, renders it difficult to obtain proper asepsis during operation, and if resection is decided upon there may be considerable trouble in uniting the distended to the

collapsed segment of bowel. If the condition is acute the absorbed toxins depress the heart's action and the abdominal distention interferes with the action of the diaphragm; if chronic the interference with the progress of the food causes indigestion, nausea, gas and abdominal distention. In suspected tumors of the large intestine careful examination should be made to arrive at a diagnosis before the stage of obstruction is reached. In the majority of instances the patient will have had symptoms upon which an early diagnosis of beginning obstruction can be made. There is, first, irregular bowel action, alternating constipation and diarrhœa with an unsatisfied feeling after stool; the movement failing to give complete relief. Second, cramps in the abdomen attended by borborygmus, and *the patient will nearly always be able to locate the site of obstruction* as it will be found at the point where the internal pressure is most intense. Third, on palpation the peculiar localized stiffening of the intestinal wall on the proximal side of the structure gives a "tumor-like feel" to the examining fingers which appears and disappears and is usually accompanied by gurgling of fluids and gases at the point of obstruction. Complete relaxation without anæsthesia can usually be obtained in the hot-water bath and a tumor, if present, can be detected. In low-lying tumors the sigmoidoscope may reach the growth. Several times I have found a sigmoid tumor prolapsed into the rectum following a large soapy water enemata, so that it could be felt with the examining finger.

The danger of drowning from the regurgitation of intestinal contents during anæsthesia should not be forgotten, and every case of obstruction should have the stomach emptied previous to operation. As a matter of fact, by careful attention to emptying the stomach and the use of saline enematas, a great many patients can be tided through a serious attack of obstruction, and the operation performed later under more favorable conditions.

The Incision.—In proposed resection of the large intestine the incision should be placed to the inner side of the seat of the

disease. If the diagnosis has not been established it is best to make a median incision through which the hand can be used to explore the abdomen. A second working incision can then be made at the most convenient situation. The utmost care must be taken to prevent infection from intestinal contents. If the proximal gut is greatly distended it will be best to make a temporary incision into it at a point where the mesocolon is sufficiently long to allow its being drawn well out of the abdomen, and with a tube empty the contained material after the method of Monks. Treves states that emptying the distended intestine at a point above the obstruction has reduced the mortality of operations one half, in acute conditions.

Mobilization.—The most important technical feature is mobilization of the large intestine for purposes of operation. The large intestine has a very long mesentery because all of its blood, nerve and lymph supply lies in the inner leaf of the mesentery and arises from the abdominal aorta and vena cava or in that vicinity. It is true that the outer leaf of the mesentery is exceedingly short, if not absent, in the ascending and descending colon and iliac sigmoid; but as the outer leaf contains no structures of importance it is only necessary to divide it, lift the colon from its bed and swing it on its inner leaf to the midline. Therefore, the *sine qua non* for efficient operation is to locate the lesion, divide the peritoneal reflection to the abdominal wall, which mobilizes the part and allows it to be completely drawn outside of the abdomen where it can be adequately surrounded with aseptic pads for clean work. By holding the color up to the light the blood vessels can be identified in the inner leaf of the mesentery, and caught, tied and divided. Mr. Moynihan shows that in this way even the descending colon may be mobilized so that it can be anastomosed with the rectum or even brought down to the sphincter muscles. The transverse colon can be readily mobilized by dividing the gastrocolic omentum.

In separating the colon and ligating the blood vessels there are some structures that must be identified.

First, the *duodenum*, a portion of which is bared in making

a proper exposure of the ascending colon and the hepatic flexure. For this reason great pains should be used in the ligation of the right colic and right branches of the middle colic vessels so the duodenum will not be injured or caught in the teeth of the forceps during operation (Fig. 2).

Second, the *ureters* must be identified and separated from adherent growths of the ileocæcal coil and ascending colon on the right side, on the left from the descending colon, and especially from the sigmoid. It must not be forgotten that just after the ureters cross the common iliac vessels they are adherent to the peritoneum and that as the colon is mobilized and pushed toward the median line the ureters go with it. Almost invariably the left ureter will be carried with the sigmoid and should be identified and separated before the resection is commenced (Fig. 2).

Third, the vasa deferentia are closely associated with the lowest sigmoid and rectum and while not so important, they should be protected from accidental injury.

The mobilization of the lowest sigmoid is readily effected by incisions along the broad ligament just under the ovaries and tubes in the female, or at the same situation in the male. These are joined by a transverse incision at the bottom of the Douglas pouch. By identifying and separating the ureters this entire portion of the bowel can be lifted cleanly from the hollow of the sacrum. The superior rectal artery comes readily with the intestine, but the middle sacral, which is usually present, and may be of considerable size, must be caught and tied.

In the removal of malignant growths of the large intestine, it will sometimes be found that a neighboring viscus has become involved and is attached to it. If conditions otherwise are favorable this should not be looked upon as a contraindication to operation. We have in such cases five times resected portions of the small intestine, on two occasions resecting two entirely independent loops of ileum, and after completing the resection of the small intestine we have removed the diseased colon with the fragments of small intestine attached.

Twice we have removed portions of the stomach which were attached to tumors of the transverse colon, and three times the bladder has been involved, necessitating partial removal of the bladder wall. One of these cases was very interesting because of the now three-year recovery of the patient after the removal of a considerable portion of the bladder wall, which was attached to and involved in a low-lying sigmoid cancer. Quite frequently in the female the ovaries, tubes and uterus become attached to sigmoid growths, and it adds but little to the difficulties and dangers of the operation to remove these attached organs from before backward in one mass with the original disease.

Method of Anastomosis.—In our experience it has made comparatively little difference by what method the anastomosis was accomplished as long as the opening was large enough. Granting that end-to-end intestinal union is ideal, the result of the lateral, or end to side, have been, functionally, just as satisfactory. In union between the large and small intestine we have usually made the lateral operation by suture, leaving as small a pouch as possible beyond the opening—and it seems to be quite immaterial whether it is made isoperistaltic or anti-peristaltic—which ever way the intestine will come together without angulation or traction; but in lateral union between two parts of the large intestine the resection should be iso-peristaltic and the openings brought close to the stump ends so as not to leave a distal pouch. Ileocolostomy is the safe operation because the contents of the ileum are fluid as compared with the solid or semi-solid character of the matter in the colon.

In end-to-end resection of the large intestine it is rather necessary for a safe anastomosis that at least one of the fragments should be well surrounded by peritoneum. In the ascending and descending colon and the iliac sigmoid, the inadequacy of the peritoneal covering may result in fistula formation, a condition which is most troublesome to heal.

For this reason in like cases resection of the sigmoid has a much higher mortality than resection of the cæcum.

The lateral operation gives very satisfactory results in such cases. If there is marked obstruction and distention, the three-stage operation of Mickulicz and Paul has much to commend it. At the first operation the tumor, with the mesentery and glands well detached, is drawn out of the wound and the proximal and distal loops united by sutures. The part to be excised is then, if possible, drawn through a separate incision in the abdominal wall of just sufficient size to carry it easily and hold it in good position. The peritoneum is united by a few interrupted sutures to the two limbs of the intestine on the inner aspect. If the symptoms of obstruction are severe, a small incision is made in the exposed mass proximal to the obstruction, and a rubber tube is introduced through which the intestinal contents are carried into a receptacle. The tumor with the attached intestine is cut away on the third to fifth day and a heavy clamp applied to the spur on the twelfth to sixteenth day; this bites its way through about six days later.

Of late, we are doing the three-stage operation less frequently, as it does not permit of such extensive and careful dissection as is necessary for the removal of the lymph channels, and the patient is subjected not only to a tiresome convalescence and unpleasant external fecal discharge for a number of days, but a secondary operation may become necessary for complete cure on account of fecal fistula.

In all resections we now use the two-row suture method with holding-clamps, and I would say again that the importance of the method of anastomosis, whether end-to-end, side-to-side or end-to-side, has been exaggerated. The more nearly the intestine approaches the normal the better the prospects of end-to-end anastomosis, but with a distended intestine from obstruction, the less the mesenteric attachment is handled the better, and the lateral method is safe and satisfactory. On several occasions I have had an opportunity to see the result of lateral anastomosis after one year or more, and only a small elbow, at most, marked the site of the union.

In making resections one is not always satisfied with the appearance of the bowel union, and fears leakage. We have

in several instances fastened the anastomosed part to the peritoneum just underneath the incision, carrying down to it strips of rubber tissue so that if leakage occurred it could readily make its way to the surface, or the entire anastomosis can be suspended on a roll of rubber tissue in such manner that in a few hours it will become protected by adhesions to the peritoneum at the site of the abdominal wound. Gauze should not be used for this purpose as it becomes entangled in the plastic lymph and is quite often followed by fistula.

There is a group of low-lying sigmoid tumors which are exceedingly difficult to get at and where a combined abdominal and perineal operation becomes necessary. As a rule, the whole of the rectum must be removed and the sigmoid attached to the anal muscles, although occasionally the cut end can be united directly to the rectal stump by the method of Tuttle, Maunsel or Weir. After direct union between the sigmoid and rectum we have passed a three-fourth inch rubber tube with an oblique end and lateral eye from the anus upward into the sigmoid several inches above the union and fastened it by a suture to the anal margin. This tube is left from four to ten days to carry gas and fæces by the suture line. In two cases of this type we closed the end of the rectum completely, leaving it as a pouch, and made a permanent left inguinal colostomy.

The abdominoperineal operation for low-lying sigmoid growths has been unusually fatal in fleshy males. On two occasions, in males weighing 200 pounds or more, we have removed the tumor by the posterior route, by an incision which passed from the anus upward along the left side of the sacrum, excising the coccyx. The anus was closed with sutures and the rectum dissected out of its muscular bed. The peritoneum was opened in front and the entire rectum with the fat and glands lifted from the seminal vesicles, prostate and bladder. By lateral incisions the peritoneum was separated and the rectum, tumor and necessary sigmoid amputated, the proximal end of the sigmoid carried down to and sutured into the muscles below. We have followed the recommendation of Peck and left the distal end of the sigmoid closely sutured for

four to seven days following operation. In this way we have obtained complete primary union and had a fair muscular control in four weeks.

One would suppose that complete obstruction of the intestinal stump for several days would lead to great distress if not to more serious effect upon the patient, but if the bowel is allowed to become quiet for twenty-four hours before operation, and if during the time of complete obstruction the patient is kept on albumin water, strained soups, etc., the majority will go three or four days, or more, without much trouble. This effect can be continued for a day or two longer if the gas pressure becomes great, by putting a small cannula with a rubber tube attached into the projecting sigmoid stump, to carry off the gas.

In several low-lying carcinomas in the female, where the patient was very much reduced from bleeding and sepsis, we have done the Quenu-Tuttle perineal resection of the entire rectum and lower sigmoid with satisfaction.

I am quite well aware that the posterior and perineal routes are not to be recommended for sigmoid tumors, but in the obese and the very anæmic, operations of this type are well borne, and have, in our hands, been followed by complete recovery.

Any one trying it for the first time in these cases will be surprised at the ease and safety with which the rectum, sigmoid, and tumor can be removed, together with the fat and glands, to a point as high as the promontory of the sacrum.

III.—ONE HUNDRED CONSECUTIVE RESECTIONS OF THE LARGE INTESTINE IN THE ADULT.

In the 100 resections there were 12 deaths, a mortality of 12 per cent. Most of the deaths were due to sepsis and exhaustion, and they illustrate the baneful influence of obstruction which was present in nearly all of the fatal cases. This brings up the question as to whether preliminary colostomy or enterostomy is generally advisable as a preparatory measure in severe obstruction.

When it is possible, we prefer to resect at the primary operation, contenting ourselves with emptying the proximal side of the intestine of its contents. But if the intestinal wall is thickened and soggy, threatening the security of the suture line, a preliminary colostomy is advantageous. The opening is not, as a rule, closed at the time of resection, but is allowed to remain open as a safety-valve and closed later if necessary.

Of the 100 resections 61 were for malignant disease with 8 deaths, and 39 for benign conditions with four deaths. Surgically speaking, it is wise to consider malignant disease of the colon in three anatomical groups.

GROUP I. *Cancer.—The Cæcum and Ascending Colon* was removed for cancer 24 times with 3 deaths. Twenty-three were carcinoma with 2 deaths, and 1 sarcoma with no operative mortality.

GROUP II.—*The Transverse Colon,* including the hepatic and splenic flexure, was removed for carcinomatous neoplasm 7 times with 1 death.

GROUP III.—*The Descending Colon and Sigmoid* was excised for carcinoma 30 times with 4 deaths.

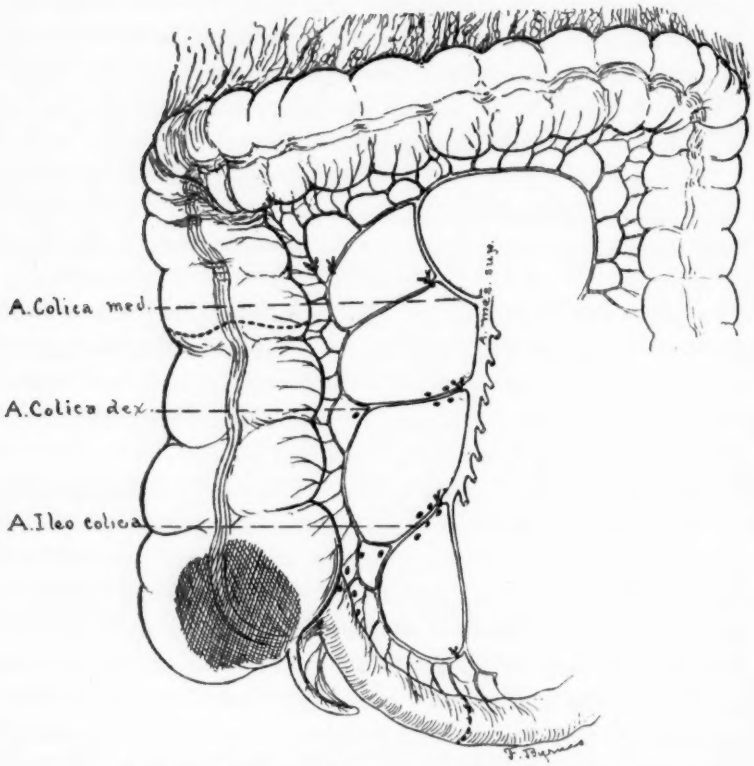
GROUP I. *The Cæcum* (Figs. 3 and 4).—The ascending colon is classed with the cæcum because many cancers involve the margin of the ileocæcal orifice and extend upward into the ascending colon and downward into the cæcum, therefore possibly involving the ileocolic and right colic group of glands.

The first step in the resection of the head of the colon is to liberate the cæcum and ascending colon by an incision through the outer peritoneal attachment, and with a piece of gauze the intestine with the tumor and fat is wiped cleanly to the muscles as far as the superior mesenteric origin of the ileocolic and right colic vessels, which are tied at once, enabling a sure dissection of the mesenteric glands and fat.

The greater ease and safety with which union between the small and large intestine can be secured as contrasted with resection in continuity of the colon, is of great technical advantage. This is equally true of resection of the hepatic flexure. Looked at from a purely technical standpoint, a car-

cinoma existing at any point between the ileocæcal orifice and the juncture of the right with the middle two-thirds of the transverse colon can be most safely treated by complete resection of all the large bowel up to that point, and this also most effectually removes the lymphatics.

FIG. 3.



Carcinoma of cæcum. Dotted lines show lines of resection.

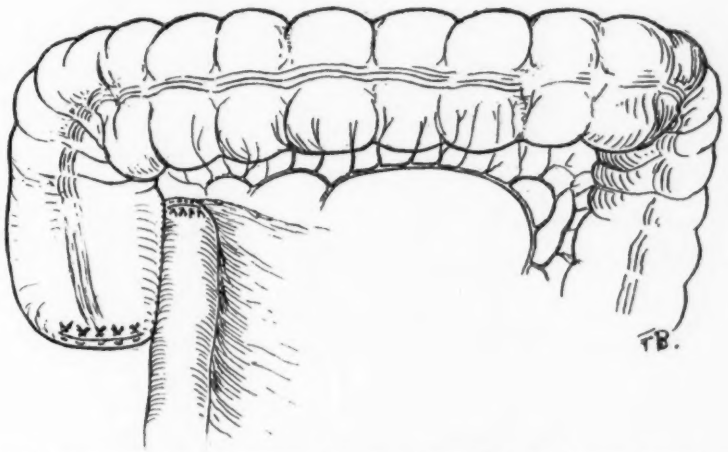
In carcinoma of the cæcum it is necessary to remove the ileocæcal group of glands with the ileocæcal mesentery, and, therefore, not less than the terminal 6 inches of the ileum must be excised. The ascending colon should also be excised in order to secure the right colic vessels and tributary glands.

The type of disease was usually found to be *adenocarcinoma* and the ileocolic glands were nearly always affected.

In some specimens the disease appeared to have had its origin in the appendix. However, the appendix was so thoroughly involved as to make it impossible to arrive at any accurate conclusion on that point.

In the past three years we have operated upon and recognized microscopically six cases of primary appendiceal carcinoma, one-fifth of one per cent. of the total operations for appendicitis in that time. As pointed out by Harte, cancer of the appendix is usually of small size, not larger than a pecan

FIG. 4.



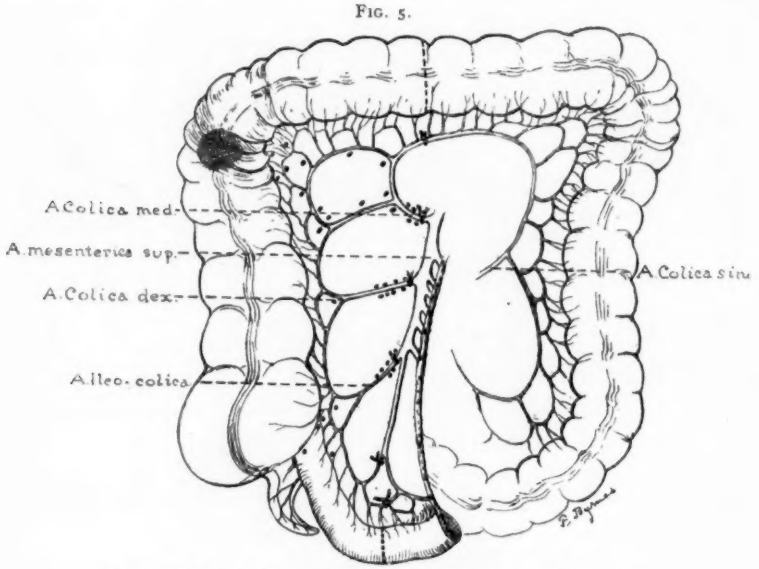
Lateral anastomosis following excision of cæcum and ascending colon, between lower ileum and hepatic flexure.

nut. It is seen most frequently in the second and third decades as contrasted with adenocarcinoma of the cæcum, which is most frequent in the fourth and fifth decades of life. Primary carcinoma of the appendix is of the spheroidal or basal-cell type. It seldom involves the lymph nodes, although LeConte reports one such case. In two of our cases the microscopic resemblance to endothelioma was striking. While in our cases of primary carcinoma of the appendix the cæcum was usually partially resected, they are not included in the statistics as the continuity of the intestinal canal was not affected by the operation.

GROUP II. *Cancer of the Transverse Colon and Flexures* (Figs. 5 and 6).—In this group there were 7 cases with 1 death. The percentage of inoperable carcinomas of the transverse colon in which no operation could be done was higher than in any other group, as there appeared to be relatively early involvement of the lymph nodes about the head of the pancreas.

In resections involving the middle of the transverse colon, the middle colic artery should be ligated early and the separa-

FIG. 5.



Cancer of hepatic flexure. Dotted lines show proposed resection.

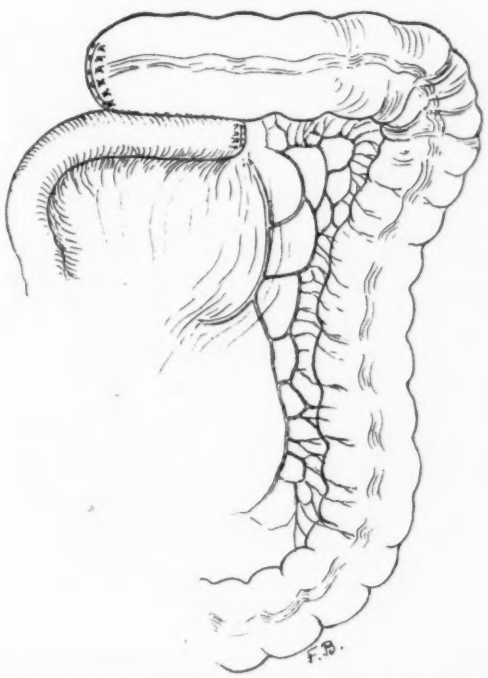
tion of the glands started with that vessel. This will at once show the extent of the devitalized colon which must be removed.

Involvement of the splenic flexure is prone to early and extensive adhesions, and local extension along these pathways of the carcinomatous process is a more frequent bar to resection than lymph metastasis. If the costocolic ligament and the outer peritoneal attachments are divided as the first step of the operation, the splenic flexure is liberated, and with the

glands and fat can be drawn well out of the abdomen, and early ligation of the right and left colics at proper points facilitates further manipulations.

GROUP III. *Cancer of the Descending Colon and Sigmoid* (Figs. 7 and 8).—In this group there were 30 cases with 4 deaths. The steps of operation are similar to those

FIG. 6.



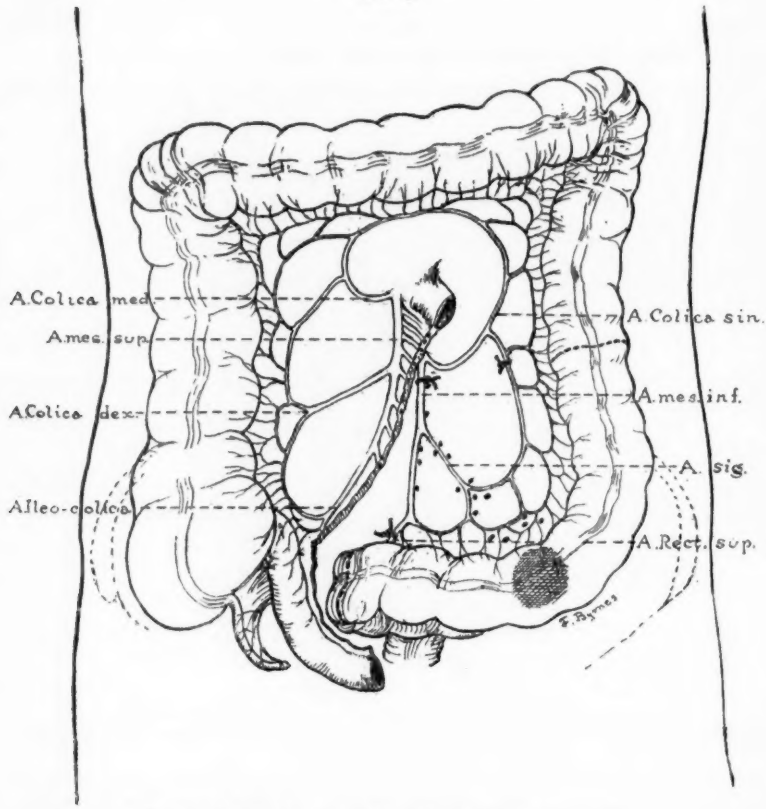
Lateral anastomosis following resection of hepatic flexure between lower ileum and transverse colon.

of the cæcum and ascending colon. Liberation by division of the outer peritoneal folds, and early ligation of the blood vessels at their origin, enables easy removal of the glands and fat so that resection can be completed outside of the abdominal cavity. Ideal resections with complete removal of the lymphatic tributaries may necessitate ligation of the inferior mesenteric vessel on account of the importance of securing that gland, which, according to Moynihan, almost

invariably lies at its origin. Wide removal of the peritoneum and surrounding fat is as necessary as the removal of the glands.

Resections for Benign Disease of the Large Intestine.—Of the 39 resections for benign conditions, 2 involved the

FIG. 7.



Cancer of sigmoid. Dotted lines show proposed resection.

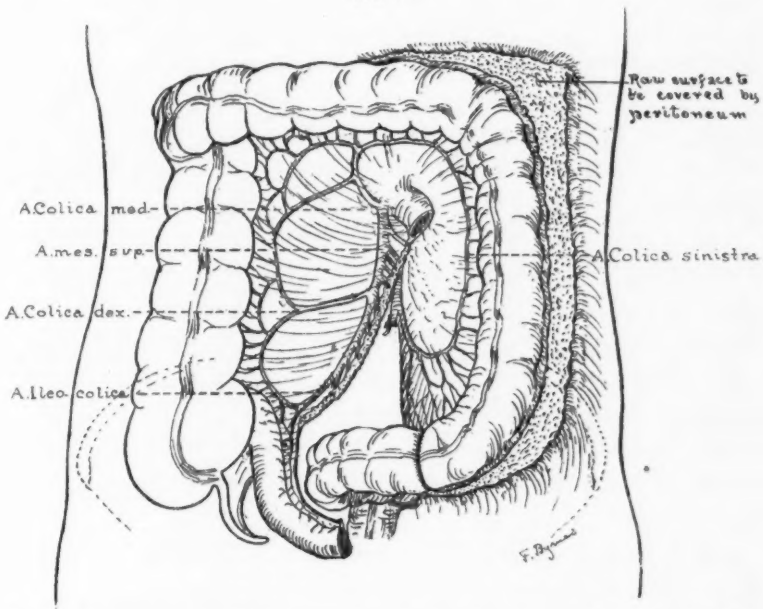
entire colon; both recovered. Twenty-four involved the cæcum and ascending colon with 1 death. Two of the transverse colon with 1 death, and 11 of the sigmoid with 2 deaths.

GROUP I. *Two Colectomies for Chronic Ulcerative Colitis.*—Nearly all the colon was removed; both made a good recovery.

GROUP II. *Cæcum and Ascending Colon.*—There were 24 resections of the cæcum and ascending colon with 1 death.

(*a*) *Inflammatory Disease,* 11 with 1 death.—This group is made up of an assortment of inflammatory conditions in which the continuity of the bowel had been destroyed by infection or its results, such as, sloughing causing large fecal anus at the ileocæcal juncture, impossible of closure by plastic operation.

FIG. 8.



End-to-end anastomosis following resection of sigmoid. Note mobilization of splenic flexure and descending colon.

Three of the latter resections required simultaneous resection of the sigmoid because of previous attempts, not in our clinic, at closing the fecal anus by anastomosing the cæcum to the sigmoid. Attempts to cure fecal fistula by performing lateral anastomosis with the view that short circuiting would permit the fistula to heal is usually a mistake. If there is no obstruction, the vermicular action of the intestine constantly tends to carry the ingesta past the artificial opening along the normal lines of the bowel, and not only is the patient not cured

of the disease but a serious complication is added when later it becomes necessary to operate for a definite cure of the lesion. It is a simple matter to circumscribe a fecal fistula by an incision down to the peritoneum at some point outside of the intestinal adhesions and introduce the finger as a guide. The less firm adhesions are swept loose and the circumscribing incision deepened through into the peritoneal cavity. The intestinal loop containing the fistula can be drawn out upon the surface of the abdomen, surrounded with gauze and the fistula closed in the long axis of the intestine by two rows of sutures, the outer row preferably of interrupted linen or silk.

(*b*) *Intussusception.*—A benign fibromyoma of considerable size growing from the vicinity of the ileocæcal valves and projecting into the lumen of the cæcum, causing intussusception, was subjected to resection with cure.

(*c*) *Localized Tuberculosis.*—Twelve cases with no deaths. Tuberculosis of the ileocæcal coil occurs in two forms—ulcerous and hypertrophic. Only one of the ulcerous type was subjected to excision, although a few patients were seen who, when they came under observation, were in a poor general condition with extensive fistulous tracts associated with multiple tuberculosis in the small intestine, and usually with pulmonary involvement. Eleven of the resections were for hypertrophic tuberculosis with well marked tumor, and in the majority it was difficult to differentiate them from carcinoma at the time of the operation.

In addition to these 12 cases in which resection for tuberculosis was performed there were a number in which the local condition was looked upon as being inoperable and some form of exclusion operation was made as a palliation for obstruction. This was particularly true in our early experience before we became aware of the extent to which these operations could be carried, also because we looked upon irremovable lymphatic glands to be a contra-indication to resection. In several instances we have removed hypertrophic tuberculosis of the cæcum with the ileocolic glands, and have left huge tuberculous glands extending up along the aorta as high as the

diaphragm, their size varying from that of a walnut to an egg, with complete and permanent cure of the patient. Shutting off the supply of infection evidently enabled nature to overcome the poison which had already been absorbed into the glandular system. In several of the specimens the bovine type only of tubercle bacilli were found to be present.

In 54 cases, 1 per cent. of the total number of appendectomies, the appendix was the seat of tuberculosis. The cæcum was nearly always involved at the base and extensively removed. These cases are not included in the statistics because the continuity of the bowel was not interfered with in the operation. Many were apparently the original focus of an extensive tuberculous peritonitis and the operation was undertaken for this symptomatic condition.

GROUP II. *Resection of the Transverse Colon.*—The transverse colon was resected twice for benign disease, once for diverticulitis and once for fibrolipoma, with 1 death.

GROUP III. *Sigmoid.*—The sigmoid was resected 11 times with 2 deaths. (*a*) In one case of Hirschsprung's disease, or giant colon, the sigmoid with the ascending and transverse colon was excised with cure. (*b*) Fibrolipoma, 1 resection with recovery. (*c*) Two for tuberculosis, 1 of the ulcerous type and 1 of the hypertrophic variety; both recovered. (*d*) Five were for diverticulitis with two deaths. This last-named condition is very curious and is due to pouching of the mucous membrane through small defects in the muscular coat of the colon in which fecal concretions form and result in acute or chronic inflammation. A well defined tumor is usually to be felt which is tender during the acute stage and accompanied by mild general symptoms of infection. These tumors have often been diagnosed as carcinoma, and in three out of five resections for this condition in the colon the diagnosis was only cleared up with the microscope. For a full report of five of these cases see article by Mayo, Wilson and Griffin, in *Surgery, Gynecology and Obstetrics*, July, 1907.

The sigmoid was resected for inflammatory pelvic disease two times with recovery.

In the group of resections we have not included a considerable number in which the sigmoid was more or less involved or injured in the course of operation for diseases of the pelvic organs, as the consideration of these should be undertaken in connection with the diseased processes of which they were the accidental rather than a primary part.

I am indebted to Dr. M. S. Henderson for compiling the following table of statistics from the records at St. Mary's Hospital, and also for the correspondence involved in ascertaining the present condition of the patients.

ONE HUNDRED CONSECUTIVE RESECTIONS OF THE LARGE INTESTINE IN THE ADULT. OPERATIONS PERFORMED AT ST. MARY'S HOSPITAL, ROCHESTER, MINNESOTA, BETWEEN FEBRUARY, 1898 AND FEBRUARY, 1909.

Of the 100 resections 61 were for malignant disease with 8 deaths (13 per cent.).

CANCER OF THE CÆCUM AND ASCENDING COLON.

Number of cases	24
Male	17
Female	7
Age of oldest	72
Age of youngest	31
Average age	48
Patients of ages between 30 and 40 years	7
Patients of ages between 40 and 50 years	11
Patients of ages between 50 and 60 years	2
Patients of ages between 60 and 70 years	3
Patients of ages between 70 and 80 years	1
Average duration of symptoms 13 months.	
Operative mortality (12.5 per cent.)	3
Patients dying within 1 year after operation	1
Patients dying between 1 and 2 years after operation	3
Patients alive less than 1 year after operation	2
Patients alive 1 to 2 years after operation	2
Patients alive 2 to 3 years after operation	3
Patients alive 3 to 4 years after operation	2
Patients alive 4 to 5 years after operation	1
Patients alive 5 to 6 years after operation	1
Patients alive 6 to 7 years after operation	1
Patients alive 7 to 8 years after operation	1
Number not located	3
Total	24

Of 11 patients operated upon more than 3 years ago, 10 have been traced. Six, or 60 per cent., are alive and well to date.

CANCER OF THE TRANSVERSE COLON INCLUDING THE HEPATIC AND SPLENIC FLEXURES.

Number of cases	7
Male	2
Female	5
Age of oldest	66
Age of youngest	35
Average age	52
Patients of ages between 30 and 40 years	1
Patients of ages between 40 and 50 years	2
Patients of ages between 50 and 60 years	2
Patients of ages between 60 and 70 years	2
Average duration of symptoms 16 months.	
Operative mortality (14 per cent.)	1
Patients dying 1½ years after operation	1
Patients dying 2 years after operation	1
Patients alive and well 1 year after operation	2
Patients alive and well 3 years after operation	1
Number not located	1
Total	7

CANCER OF THE SIGMOID.

Number of cases	30
Male	21
Female	9
Age of the oldest	71
Age of the youngest	31
Average age	52
Patients of ages between 30 and 40 years	5
Patients of ages between 40 and 50 years	7
Patients of ages between 50 and 60 years	8
Patients of ages between 60 and 70 years	8
Patients of ages between 70 and 80 years	2
Average duration of symptoms 2 years.	
Operative mortality (13 per cent.)	4
Patients dying 1 year or less after operation	3
Patients dying 1 to 2 years after operation	5
Patients dying 2 to 3 years after operation	1
Patients alive and well 1 year after operation	7
Patients alive and well 1 to 2 years after operation	5
Patients alive and well 2 to 3 years after operation	2
Patients alive and well 3 to 4 years after operation	3
Total	30

Out of 6 cases operated upon more than 3 years ago, 3, or 50 per cent., are alive and well.

RESECTIONS FOR BENIGN DISEASES OF THE LARGE INTESTINE.

Number of cases	(4 deaths—10 per cent.)	39
Colectomy for ulcerative colitis (nearly all of the colon removed)		2
Cæcum and ascending colon		24
Localized tuberculosis		12
Inflammatory disease		11
Intussusception		1
Transverse colon, including hepatic and splenic flexures		2
Diverticulitis		1
Fibrolipoma	(1 death)	1
Descending colon and sigmoid		11
Tuberculosis		2
Diverticulitis	(2 deaths)	5
Fibrolipoma		1
Hirschsprung's disease		1
Inflammatory disease		2
Total		39

DISTORTION OF THE MESENTERY AND ITS RELATION TO INTESTINAL OBSTRUCTION.*

BY JOSEPH D. BRYANT, M.D.,

OF NEW YORK,

Surgeon to Bellevue and St. Vincent's Hospitals.

For the purposes of this occasion, Distortion of the Mesentery is considered to mean the twisting or otherwise forcing out of shape of the mesentery by disease process, and thereby so disarranging its normal relation with the attached intestine as to change the orderly course of the latter with reference to it. Torsion of the mesentery, as commonly expressed, is not included in this title. It seems not at all unreasonable to conceive that the forcing out of shape in this manner of the mesenteric curtain, to the lower border of which the intestine is attached, would change the normal relations existing between them to a sufficient degree as to modify correspondingly the functions of the included intestine.

The stimulus prompting the conception of the title and promoting the birth of this paper, had its origin in the strikingly interesting, and, to me, instructive features incident to a case recently coming under my notice from lay sources, which was characterized by long-standing and progressively increasing symptoms indicative of intestinal obstruction. The nature of the obstructing cause was at first problematical, being regarded as functional; then, as functional with organic complications, the latter of which finally dominated the varying picture of distress so long as the patient remained under observation. It, therefore, naturally follows that the syndrome of this case is divided into two parts, viz.: the early or the recounted part, and the later or the observed part, at least, so far as the writer is concerned. And, in expressing the indications of disorder in this instance, especially those manifestations will be told which are regarded as not being inconsistent with a belief in the peculiar nature of the obstruc-

* Read by title before the American Surgical Association, June 3, 1909.

tion, and its probable location. A plan like this necessarily eliminates, except for comparison, many of the multitude of common symptoms of intestinal obstruction, and correspondingly abbreviates and emphasizes the text and the facts that are regarded as being expressly related to the problem.

It appeared, in this instance, according to the recounted symptoms, that, at longer or shorter intervals of time for several years, there had occurred brief attacks of intestinal colic usually accompanied with nausea and vomiting, as the distinguishing traits. The frequency and severity of the attacks, though differing in degree from time to time, gradually increased in these respects, until the uncertainty of the time of their coming and going, and of their severity, obviously founded a most unhappy and insecure state of affairs. Usually, in these instances, however, a mild anodyne, supplemented with a gentle cathartic, afforded prompt relief—a relief commonly marked by copious evacuations of semi-solid material, sometimes with distinctive features of indigestion, but with no evidence of obstruction. Afterward, however, a decided change occurred in this, the negative feature of the case. For, in an attack apparently induced, as often before, by indiscretion in diet, it is recounted that there developed after twenty-four hours, genuine symptoms of intestinal obstruction, which refused obedience for forty-eight hours longer to the usual remedial means employed in these instances. Soon after, however, a copious bowel evacuation succeeded an escape of offensive flatus, the apparent sequel of a deferred, hopefully employed, high enema. Complete comfort followed at once. But, singularly enough, within an hour after the stool, nausea ensued which was promptly and finally relieved by abundant vomit having a distinct fecal odor. Also, it is told that during the height of this attack, the turpentine and the asafœtida separately employed in the high enemata for the purpose of fecal dislodgement were tasted by the patient soon after their introduction. A fact which happened thereafter, it is said, on two occasions with the use of asafœtida with a similar intention. After the prompt subsidence of this attack, I was told that comparative quiet reigned in the abdominal affairs of the patient for nearly eighteen months. Before, during, and subsequent, to this attack, nothing of diagnostic significance related to the affliction, could be ascertained by physical examination so long as the

patient came under our notice. Later, the painful digestive attacks increased in frequency, happening once in four or five weeks, in fact, were not infrequently prompt complications of slight constipation and of errors in diet. And, too, before final relief from an attack came in sight, fecal vomit in varying amounts was in evidence—at least, once in three or four months. And, at one time, the attacks bid fair to wear the patient out through the torment of spirit and physique, which they imposed at uncertain intervals.

The pain was rarely severe, it being often readily controlled by a small amount (⅛ or $^1/_{10}$ grain and less) of morphia, given hypodermically once in six or eight hours. The pain was located primarily, and throughout the attack, in the navel region. It sometimes came suddenly without premonition; again with a sense of indefinite gastric or abdominal distress; and often in a gradual manner, with or without important manifestations. Some general tenderness of the abdomen was present, especially if the attack was severe, but no circumscribed points of tenderness could be determined in slight or severe attacks until late in the history of the case, when, after severe attacks, varying and vague points of tenderness were noted only in the navel region. The region of the appendix and of the gall-bladder, however, was free from all uncomfortable manifestations. Local or general tension of the abdominal muscles was never observed. Tympany was absent during slight attacks, and was not pronounced during the severe. The pulse exhibited but little change from normal, except during the later part of my observation, when it, very naturally, was accelerated by pain and fever. The temperature (rectal) rarely reached 100 F. until during the later attacks, when it would go up a degree or two, and even higher, and then suddenly fall a degree or more in a few hours (6 or 8) before the symptoms of obstruction were relieved, usually by copious alvine dejections. So constant was this phenomenon in these later attacks as to become of special significance as indicating approaching relief. During the last two attacks known to me, the remission was quickly followed by abdominal pain, and return of temperature which, soon after, resumed the usual low figure of the preceding attacks. It would seem as if in these special instances, brief arrest of recovery had happened, resulting, perhaps, in slight re-obstruction and consequent increased degree of infection. Especially so, since their temperature of 103 F. and 104

F. for a short time, would then suddenly fall to nearly normal, attended with perspiration. Nausea was common with the onset of the pain, and often vomiting, the vomit being composed usually of the contents of the stomach, followed by bile. In several instances, however, the vomit became fecal, sometimes very promptly and unexpectedly, and once, primarily, then again, later in the course of the attacks. In one instance, free fecal vomiting, and a simultaneous large stool terminated at once a seventy-hour period of apparent obstruction. In this instance, the physical characteristics of the two discharges, oral and anal, were similar in color, odor, and consistency. The color was brown, the odor fecal, and the consistency semifluid. A chemical examination of these discharges disclosed the presence of indol and skatol in each, and with but little more of these agents in the stool than in the vomit,—a difference which, at the time, might well have prompted the thought that the intestinal obstruction, in this instance, divided somewhat equally the field of abnormal development of these substances. For, were the obstruction located at the proximal side of the region of development, one would not expect the presence of either substance in the vomit.

In the majority of attacks, the symptoms of intestinal obstruction yielded quite promptly to high enemata and colonic irrigation. At times, however, these agents produced no apparent effect, even on repeated employment. It sometimes would seem as if the obstruction—at uncertain periods (30 to 75 hours after attack)—would yield more to intestinal effort than to human contributing influences. That is to say, the morbid physiology of the intestine itself apparently was more potent for relief on these occasions than were the special efforts of those in charge of the case. In one instance, however, when other measures afforded no relief, two quarts of warm sweet oil, slowly introduced as high as possible into the bowel, were, in the course of an hour, followed by copious discharges of soft fecal content, succeeded by prompt relief lasting for a brief period. A curious sequel to this experience was the frequent passage in the stools for about twenty-four hours, of varying small amounts of sweet oil. It appeared as if the oil had been sequestered in the bowel, so as to be returned in divided portions from time to time, as the actions of the bowel would require. Also a manifestation which pointed to the presence of isolated collections of fecal matter in the small intestine, happened in two instances later in

the history of the case in the following way: The administration of a saline cathartic was followed promptly only by brown watery evacuations strongly impregnated with indol and skatol. This result would not be expected in the instance of an empty colon already rinsed well by saline catharsis and irrigation. In these instances, however, a liberal dose of castor oil was promptly followed by a large soft fecal evacuation. It therefore appeared as if the fluid dejections had passed across or through disseminated accumulated fæces in the small intestine, thus staining and impregnating them with indol and skatol. For, had the amount of fecal gathering disclosed by the cathartic been circumscribed in the small intestine, there is no doubt that tumor would have been present on manipulation, hence the belief in circumscribed dissemination. In the second instance, after ingestion of milk the rapid appearance per anum of milk-colored discharges followed by an abundant fecal movement from castor oil, suggested the presence of fecal accumulation in the small intestine, especially when the colonic irrigating fluids, just before employed, had been returned uncolored. Again on frequent occasions, test doses of two grains of bismuth by mouth, in the instance of fluid diarrhœa, promptly discolored the anal discharges, thus clearly demonstrating the fact of incomplete obstruction and the absence of a special diarrhœa of irritation from below. And, too, following this, the normal fecal discharges returned without the help of remedial agents, suggesting the further idea that but little, indeed, of the fluid discharge could have come from a local intestinal irritation caused by a fecal accumulation.

It is but fair to say at this time that careful observation and study of the phenomena noted in this case, convinced the writer that, for some reason, an S trap-like arrangement in the course of the small intestine was present, and likely, too, in plural number, at the lower curves of which passing fecal matters accumulated sufficiently on different occasions to cause more or less, and sometimes complete obstruction, often accelerated by indigestible matters of sufficient amount or suitable size, to completely and suddenly occlude the remaining part of the lumen. More often, however, it was believed that the pockets were emptied by local intestinal muscular contraction with more or less pain attendant thereon, and, at other times, wholly, or in part by the aid of cathartics, more especially castor oil. As already intimated, it was believed that at times an incomplete occlusion was present,

leaving only sufficient space to permit of the passage of saline evacuations over the fecal accumulations in the dependent parts of the receptive loops of the deformed intestine, thus tincturing the passing fluid with indol and skatol. The prompt passage, at times, of undigested milk and of bismuth-stained fluids for test purposes also served to substantiate the belief in incomplete obstruction. And, too, on careful thought no other form of intestinal obstruction appeared so well to meet the syndrome of this case. It was not improbable that this obstruction was located in the ileum not far from the cæcum, and also that the ileocæcal valve at times was pervious to fluids from below, and that active reverse peristalsis was a prominent feature.

It should not be amiss now to further interpret, so far as practicable, the other various phenomena which pointed toward and added interest to the pathologic picture just sketched.

The tasting on different occasions of the turpentine and asafœtida employed in high enemata for the purpose of overcoming intestinal obstruction, suggests at once that the obstruction could have not been complete, though so regarded at the time. Also, that reverse peristalsis had been rapid and pronounced at the time, as taste of the drugs happened during the brief retention of the enema. And, besides, for some reason, the ileocæcal valve was not on guard in a manner commonly supposed to characterize its office. In this connection, however, it is proper to say that intestinal peristalsis is not as simple a mechanism as is commonly supposed, and that antiperistalsis especially is a phenomenon the intricate nature of which is, as yet, not entirely settled.

Practically, however, antiperistalsis is reported as having carried nourishing and medicated agents from the rectum to the mouth in a brief time in many instances. The writer in 1892, in a hysterical patient, observed the vomiting from a test glycerine and methyline violet enema twenty seconds after its introduction into the bowel. A suspected communication in this case between the colon and the stomach was disproved by explorative examination. About the same time, the attachment of the divided ileum to the sigmoid flexure was practiced by the writer in order to short-circuit the intestinal

contents in the instance of an obstinate fecal fistula of the transverse colon. But, only a change in the consistency of the fecal discharge was observed, as the soft discharges of the ileum were carried up the descending colon by retrograde peristalsis, and escaped as before from the cutaneous opening of the fistula. Also, as a matter of established fact, and apparently shown by this case, a continuous peristalsis going rapidly from the rectum to the stomach, and, another kind arising at an irritated part of the intestine, and going from it in opposite directions may take place.

That the inhibitory influence of the ileocæcal valve on peristaltic intercourse of the large and small intestines cannot be regarded as definite, is evidenced by the report that in 60 per cent. of subjects (Debierre) the valve is found to be permeable from below.

It seems permissible now, to point again and more fully to symptomatic features of the case which had been regarded as being of special significance in connection with the peculiar form of obstruction to which they had been assigned. Among them may be classed the nearly equal amounts of skatol and indol contained in the fecal matters simultaneously discharged from the mouth and anus. Of course, I was aware of the flood of fallacies that beset this proposition, but, it came to my mind and was not dismissed. The normal habitat of these diagnostic products of fecal substance is peculiar to the cæcum and the first part of the colon. And, in this instance, it appears that the ileocæcal valve was pervious from the colonic side. Therefore, at first sight, it could be easily said that primarily both oral and anal dejections were largely the product of cæcal and colonic activities, whose respective exits were made possible by the presence of an obliging ileocæcal valve. But, if such had been the case, the amount of skatol and indol in the oral dejection might well have exceeded that of the anal, since, to the contents of the cæcum and nearby colon are these products easily peculiar. But inasmuch as the processes of decomposition breed skatol and indol anywhere in the intestine, in amounts proportionate to the contributing influences, and, as in this instance, the putrefaction changes

were general throughout, and, also, that an incomplete hindering obstruction of some sort was lying between the cæcum and the stomach, it was not singular, and one would expect the greater amount of these products to favor the anal exit of the area of their natural production. Also, classed as indicating the possible location and probable mechanism of the obstruction, will be recalled certain facts already stated in the early history of the case viz.: The slow development, too slow, in fact, for the progress of the common kinds of intestinal obstruction. And the associated indications conform therewith. The phenomena recounted regarding the high sweet oil enema; the colonic irrigations; the skatol and indol impregnations; the milk and bismuth exhibitions; the castor oil responses; the forecasting indications of spontaneous relief, etc., etc., appealed to the author with sufficient force to put in mind the theory already expressed, *i.e.*, "an S trap-like arrangement of probably multiple parts in the course of the small intestine." This theory was promulgated before a tangible opportunity was afforded to determine the seat and mechanism of the obstruction by means of material examination. Finally, however, by so doing, it was determined that nothing physically appreciable was at fault with the colon, the cæcum, or the appendix. The first four or five inches of the ileum were normal. The succeeding seven or eight inches and the mesentery connected therewith were abnormal, the latter being distorted by chronic inflammatory process, so as to cause scalloped irregularities of the attached intestine for a corresponding distance. The wall of the intestine at this situation was much hypertrophied, thus giving rise to marked encroachment on the lumen of the gut, which otherwise was enhanced in places by the acute angles of the scallops themselves. The intestine proximate to the obstructed part was moderately dilated and hypertrophied for a considerable distance.

The marked hypertrophy which characterized the disordered part of the intestine is regarded as the natural product of its crippled condition, especially in view of the well-known fact that the interference with the normal flow of a fluid

through its natural channel at once provokes functional resentment of a greater or lesser degree on the part of the motor forces interested with the conduct and care of the function. And, also, that the effort required to keep pace with the demands of increasing interference develops the compelling forces correspondingly, as is made manifest by the increasing growth of the responsible parts engaged in the duty of functional activity and preservation. We can quite easily understand how, as in this instance, that near-together consecutively arranged developing interferences (scallops) with intestinal function could, sooner or later, cause slight, temporary, and finally more or less decided obstruction to the flow of the intestinal contents, attended with corresponding increase in dimensions and power of the propelling force, as represented by the muscular development of the part thus directly involved.

It would appear to me that the disclosures of the examination have reasonably established the conjectural diagnosis as related to the location and the mechanism of the obstruction. Also, that the phenomena recounted in connection therewith fit the physical findings amply, certainly much better than they can be adjusted to the mechanism of a different form of intestinal obstruction.

A careful examination of the literature of intestinal obstruction as related to mesenteric distortion (not volvulus) by competent persons, reveals no instance of similar intestinal disfigurement, or of like clinical history. In one instance only it appeared that the pressure of a large tuberculous mesenteric gland on the veins of the mesentery of the ileum had produced œdematous thickening of the walls of the corresponding part of the intestine to a degree causing sufficient closure of the gut, and modification of its functions to produce acute intestinal obstruction, for which resection of the part was made.

What I have offered, on this occasion, is most respectfully submitted, and, for the time being, is all I would care to say regarding a matter which only time and multiplied opportunities can fittingly adjust to the topic of intestinal obstruction.

I. STRANGULATED RETROPERITONEAL HERNIA OF THE INTERSIGMOID FOSSA. II. INTERPARIETAL VENTRAL HERNIA AT McBURNEY'S POINT. III. RESECTION OF FOUR FEET OF INTESTINE FOR INTESTINAL OBSTRUCTION FOLLOWING REDUCTION OF STRANGULATED HERNIA EN MASSE FOUR MONTHS BEFORE.*

BY WILLIAM B. COLEY, M.D.,

OF NEW YORK,

Attending Surgeon to the General Memorial Hospital; Attending Surgeon to the Hospital for Ruptured and Crippled.

I. STRANGULATED RETROPERITONEAL HERNIA OF THE INTERSIGMOID FOSSA.

INFANT, male, born September 8, 1907, weighed 7½ pounds, apparently in every way normal at birth. The only unusual thing noticed the first 24 hours was the fact that the child cried almost constantly, and occasionally would spit up a little mucus; he had two meconium stools, passed normally. He continued to take sugar water and a mixture of 2:20 milk, without vomiting. The second day he continued to cry nearly but not quite so badly as during the first 24 hours. At the end of the second day, when the mother's milk began to come, he was put to the breast and suckled satisfactorily. There were no satisfactory bowel movements after the meconium stools, though the napkins were stained occasionally with fecal matter. I saw the child 24 hours after birth, also at the end of the first 48 hours, and could detect nothing abnormal in the abdomen. On the evening of the second day, 54 hours from birth, the nurse thought the abdomen was more distended and somewhat harder on the left side and did not think the child was exactly right. The crying continued. The baby nursed well, however, during the night; and, when seen by myself the following day at noon, 72 hours from birth, the nurse stated that the baby seemed very much better; she said it was nursing well and was getting plenty of milk from the mother. I again examined the abdomen. I found no areas of dulness and could

* Read before the American Surgical Association, June 4, 1909.

not make out any definite enlargement on the left side, which the nurse stated she had noticed the evening before. The movements, however, were not satisfactory.

In the evening of the third day, 80 hours from birth, the child developed a temperature of 102° and began to vomit. I was 16 miles away, but advised, over the telephone, passing a rectal tube and irrigating the bowel. The child had had a small dose of castor oil before. The nurse was unable to pass the tube into the rectum. The vomiting ceased and the child took some milk and slept a good deal between 8 and 10 P.M. The vomiting again began at 1 A.M. and during the two hours it required for me to reach the patient, he was seen by Dr. Mackenzie, the local physician, who tried to pass a catheter and wash out the bowel, but was unable to pass the tube more than 2 to 3 inches. On my arrival, at 4.30 AM., I again attempted to pass a catheter, and although I used three or four kinds—soft and hard—I was unable to get up higher than 3½ inches, from the anus. The catheter then seemed to meet with some obstruction beyond which it could not pass; no fluid could be forced beyond the catheter. The napkins were on two occasions at night stained with yellowish fecal matter, but there was no distinct movement. There had been considerable cyanosis at one o'clock, but at 4.30 the color seemed much better and the general condition was improved. Breathing, however, was rapid and heart action weak. The abdomen at the time of Dr. Mackenzie's visit, at 1.30 A.M., had been much distended and was harder on the left side, in which region, he stated, there was certainly a marked dulness. My examination at 4.30 showed the abdomen symmetrically distended, but there was absolutely no change in note on either side.

At 8 o'clock I made another attempt to irrigate the bowel, but failed; the catheter would go no further than on the previous occasion. I consulted with Dr. Chas. G. Kerley over the telephone and he advised again attempting an enema with Epsom salts and ox-gall. This was tried, but very little could be made to enter the bowel. The child gradually failed and died at 11 o'clock, before Dr. Kerley arrived. Although I was certain of an intestinal obstruction, the child was in no condition at any time since the vomiting began, to stand an abdominal operation.

An autopsy was made two hours after death, in the presence of Dr. Mackenzie of Millbrook, New York. On opening the

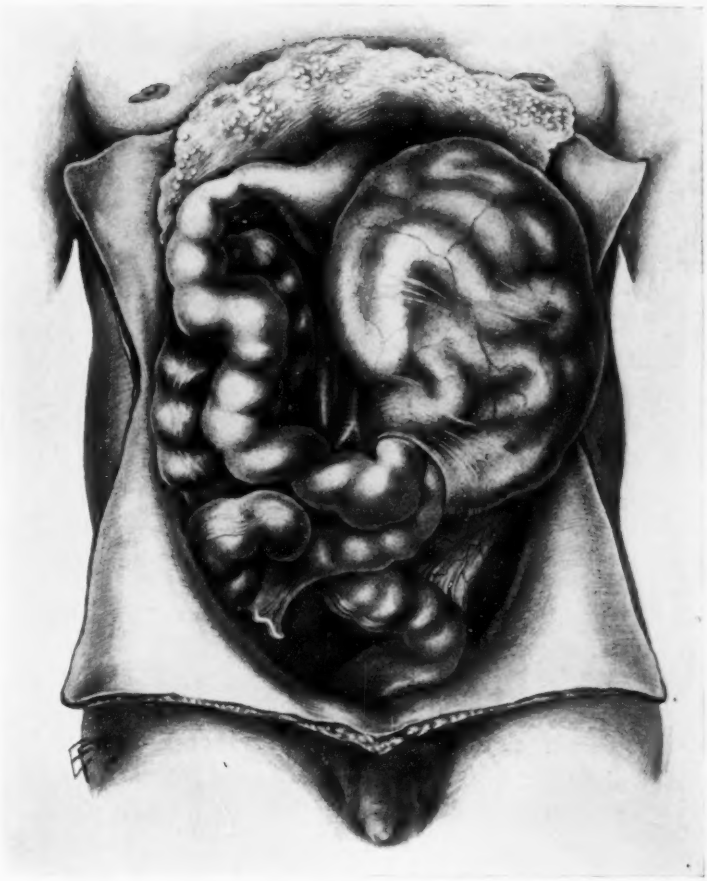
peritoneal cavity, an immense gush of air mixed with an emulsion of fæces poured out, causing the abdominal walls to collapse. Between a pint and a quart of yellowish liquid fæces (there was no pus or anything resembling purulent material present) was found lying in the abdominal cavity. When this was evacuated, I was immediately struck with the absence of the intestine. Careful search revealed only a small loop of small intestine, deeply congested and distended; there was, however, a globular tumor occupying the left side of the abdomen, beginning on a level with the bifurcation of the common iliac artery and extending up nearly to the costal arch. This swelling was smooth, symmetrical, and resilient on pressure. Finally, I discovered at the lower edge of the swelling a semilunar fold of peritoneum, situated a little to the left of the vertebral line and just on a level of the bifurcation of the iliac artery. This semilunar fold formed the neck of the retroperitoneal sac. The aperture was 1¼ inches in diameter, easily admitting the index finger (Fig. 1). The posterior parietal peritoneum had evidently been lifted forward, forming the hernial sac which contained almost the entire small intestine. The sigmoid turned sharply to the right and the whole large intestine was entirely on the right side. The intersigmoid fossa must have been abnormally large, containing some, perhaps nearly all of the small intestine at birth. On the other hand, it is possible that only a portion of the intestine occupied the fossa at birth and that the constant crying during the first two days may have forced more and more of the intestine into the sac until practically the whole small intestine was included and later strangulation occurred.

The opening in the peritoneum in this case corresponds very closely to that of Eve's, although in Eve's case the sac contained only a portion of the ileum, 6 inches in length.

Eve's case was a woman, 63 years of age, and there was present a band of adhesions between ascending colon and sigmoid flexure, which played some part in the etiology.

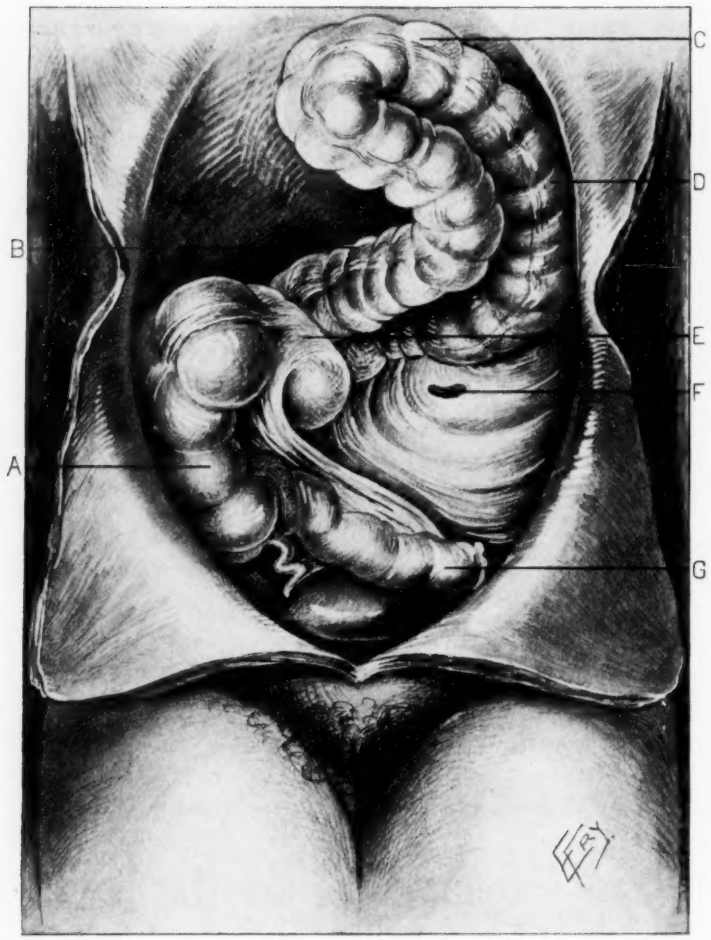
In regard to Eve's case Moynihan states that the most likely explanation is that " there had been originally a common mesentery for the jejunum, ileum, cæcum, and ascending colon. The splenic flexure and the descending colon became

FIG. 1.



Strangulated congenital hernia of the intersigmoid fossa, in child of three days old. (Coley).

FIG. 2.



Eve's Case.—*A*, Cæcum turned forwards; *B*, Ascending colon; *C*, Continuation of colon, bent on itself; *D*, Descending colon; *E*, Band of adhesion; *F*, Fossa intersigmoidea; *G*, End of ileum. (*British Medical Journal*, June 13, 1885).

fixed in the usual manner by the adhesion of the left or posterior layer of the original descending mesocolon to the parietal peritoneum of the posterior abdominal wall. As a result of peritoneal adhesion, most probably pathological, the cæcum and ascending colon had adhered to the descending colon and the sigmoid, and the united gut had been dragged over to the right, laying bare and rendering patent the orifice of the intersigmoid fossa."

In the character and amount of contents my own case corresponds very closely to the case of Treitz, a duodenojejunal or mesocolic hernia. (*La Progrès Médicale,* 1889, tome ii, p. 289.) In Treitz's case the opening of the hernial sac was in the median line a little higher up and the long diameter was perpendicular instead of horizontal. In addition, the transverse and descending colon surrounded the tumor on the upper left and lower side.

My case, as far as I can learn, is the only case of intersigmoid hernia, or for that matter, of retroperitoneal hernia existing at birth. While it is possible that, had the condition been recognized on the first day, an immediate operation might have been successful, still, the difficulties in the way of an early diagnosis in such a young infant must be regarded as very great. In this case there was no localized tumor; the child continued to take food until near the end and vomiting was a very late symptom.

The only three cases of hernia of the intersigmoid fossa that I have been able to find are the cases of Eve, McAdam Eccles, and Lambret. The two former were referred to at length by Moynihan in his well-known work on "Retroperitoneal Hernia." As to Lambret's case, Moynihan stated that he was unable to obtain the journal in which it was reported, namely, *l'Echo Médical du Nord,* 1897, p. 384.

Mr. F. S. Eve regarded his case as the first authentic case of intersigmoid hernia. It was reported in the *British Medical Journal,* June 13, 1885. The specimen has been preserved at St. Bartholomew's Hospital.

This fossa was first described by Hensing and consists of

a pouch or depression of the peritoneum forming the left or under layer of the mesosigmoidea, extending to the upper part of the sigmoid flexure.

Eve's patient was a woman aged 63 years; she was admitted to St. Bartholomew's Hospital December 31, 1882. She had always been in good health until December 26, 1882, when at 10 A.M. she was suddenly seized with violent constricting pain around the abdomen in the region of the epigastrium, followed by violent vomiting and the passage of large loose stool. She had had slight attacks similar to this before, which were relieved by purgatives. On December 27 she passed a small movement with little blood and mucus. She continued to vomit all food from the beginning of the attack. The vomitus was at first bilious in character, later became brown, with fecal odor. On December 30, the temperature was subnormal; expression anxious; abdomen was uniformly but not tensely distended; there was incessant retching, but no vomiting. The rectum was free, an enema of warm water returned with some small fecal masses and blood-stained mucus. On January 22, after a consultation, Mr. T. Smith performed the operation for lumbar colotomy. A portion of the intestine was opened and much fecal matter evacuated. The condition gradually grew worse and on the morning of the twenty-fifth she went into collapse and died.

The conditions found in Eve's case are well shown in Fig. 2. The ascending colon took a course obliquely across the abdomen to the left hypochondrium, where it turned sharply to the right and followed the curve of the diaphragm until it reached the middle line; here it became suddenly bent upon itself and returned, above and parallel to its previous course to the lower edge of the spleen; thence it took the normal direction to the sigmoid flexure. Both the ascending and descending portions of the large intestine were closely united and almost surrounded by a single layer of peritoneum. Just above the cæcum, below the level of the hernial opening, there was a band of adhesions 1 inch in breadth and one-half inch in length, binding together the ascending colon and adjacent curve of the sigmoid flexure. Eve believes that this band of adhesions created conditions favorable to a hernia into the intersigmoid fossa.

The fossa itself is not so uncommon. Treves found a perfect fossa in 52 and a funnel-shaped depression in 13, or a total of 65 per cent. of the bodies examined. De Haen ("Ratio Medendi, Paris XI de Ileo Morbo," p. 103) quoted by Moynihan, describes a case of supposed hernia in the intestine through an opening in the mesosigmoidea. This has been referred to by Treitz, but the details are not sufficiently numerous to warrant Moynihan in regarding it as a case of true intersigmoid hernia.

Eve states that it would be useless to form rules for the diagnosis of this form of hernia which the next case would falsify. In both De Haen's and his own case the patient was periodically subject to abdominal pains associated first with constricting sensations and later tympanitis, indicating that the intestine not infrequently had slipped into the opening, but had been released by purgatives or naturally.

In 1895, ten years later, McAdam Eccles (St. Bartholomew's Hospital Reports, vol. xxxi) reports a case of strangulated hernia of a loop of small intestine in the fossa intersigmoidea.

The man, 53 years of age, was admitted to the West London Hospital under the care of Mr. Eccles on August 18, 1895, with well-marked symptoms of intestinal obstruction. He had for many years suffered from double inguinal hernia, both reducible and fairly well controlled by a truss. Four days before admission, while coughing, his left hernia came down and could not be reduced. He was taken to Cottage Hospital, near his residence, in which the surgeon with little delay and some difficulty reduced the hernia by taxis. The vomiting and pain, however, persisted. No fæces or flatus passed the rectum. On the fourth day he was admitted to the West London Hospital in the following condition: Facial expression anxious and typical of acute abdominal disturbance; pulse small and frequent; breathing thoracic; tongue furred; temperature 98.2°, abdomen evenly distended and everywhere resistant; no local swelling or induration could be made out. Under ether a median abdominal incision was made. High up in the iliac fossa in the posterior part of the abdomen was a firm resistant mass into which could be traced the small intestine, one part of which was distended, the other collapsed. Closer examination revealed a tightly constricting edge which afterward proved to be the margin of the aperture of the intersigmoid fossa. The sharp ring was carefully snipped with a pair of scissors and the gut slowly drawn out of its grasp. The loop of small intestine was then liberated. This was intensely congested, and black and gangrenous for a distance of about one-half inch in its middle. The whole loop measured about four inches. The gangrenous piece of bowel with the œdematous portion was excised with a V-shaped piece of mesentery and the ends united by Maunsell's method. The patient died of exhaustion 12 hours later. The record states that the post-mortem examination showed some general peritonitis, most marked in the region of the sigmoid flexure. The suture used in the anastomosis had held well. Nothing further is said about the condition of the intersigmoid fossa as disclosed by the autopsy.

Eccles states that this fossa was distinct in at least half of the subjects examined in the Rooms in 1894-1895, the per-

centage being 53. This corresponds very closely to the findings of Treves. Eccles states that in the fœtus this fossa is undeveloped. In Eccles' case the tightness of the strangulation was extreme, showing that once a loop of bowel becomes imprisoned, it is very seriously affected in a short time.

A careful reading of the history of Eccles' case must leave some doubt in one's mind whether this condition might not have been one of reduction *en masse* rather than a true hernia of the intersigmoid fossa. The history of a case of strangulated hernia, finally reduced under forcible and prolonged taxis, with a continuation of the symptoms of strangulation is absolutely typical of a case of reduction *en masse*. It does not seem at all probable that the same loop of strangulated bowel that had been reduced from the scrotum, could have been made to enter the intersigmoid fossa after reduction. It seems still more improbable that two loops of intestine could have been simultaneously strangulated, one in the intersigmoid fossa and one in the scrotum; and that when the latter was reduced, the former continued to give the same symptoms. It is reasonable to believe that one condition could have been easily mistaken for the other through the small incision used in the laparotomy, and the actual condition not recognized except by a very thorough autopsy, evidence of which is lacking in Eccles' case. He simply states that post-mortem examination showed some general peritonitis and that the sutures used in the anastomosis held well. There is no further description of the condition present in the fossa itself. (The case has, however, been accepted by Moynihan, the most competent authority.)

The third case of hernia of the intersigmoid fossa, is that of Lambret (*L'Echo Méd. du Nord,* 1897, p. 384). Lambret reports this case as the third known case of hernia of the intersigmoid fossa, stating that the two cases observed up to that time were the case of Jomini and that of Eve. Jomini's case (*Revue Médicale de la Suisse Romande,* 1882) was not accepted as a true case by Moynihan. Lambret describes his case as follows:

Male, aged 63 years, was admitted to the hospital with all the signs of acute intestinal obstruction which had lasted for a period of three days, coming on during an effort at defecation. The patient immediately had very severe pains in the abdomen without any particular localization; vomiting occurred soon afterward and finally became fecal. It ceased the day after his admission to the hospital; there was no passage of either gas or fæces; moderate abdominal obstruction; pulse rapid. Operation was immediately decided upon and it was performed by Folet. A median incision was made from the umbilicus downward. On opening the peritoneum, a dilated intestinal coil was seen with other coils collapsed and embedded. The hand of the operator discovered in the upper part of the left iliac fossa a hard tumor, smooth, symmetrical—the nature of which it was difficult to determine. The withdrawal of the intestine was made very easily under the influence of light traction. A loop of intestine withdrawn was œdematous, purplish-red in color, but presenting no trace of constriction. The lumen of the intestine seemed permeable. The tumor perceived in the left iliac fossa at the beginning of the operation now disappeared. Reasoning from this fact, the hypothesis of a hernia in the intersigmoid fossa was advanced and the orifice of this fossa was quickly found; it was about as large as a five franc piece; its walls were infiltrated and dark-colored. The walls of the fossa were also of a purplish color and contained a certain quantity of bloody exudate. It had the appearance of a hollow sphere of sufficient size to hold a mandarin orange. The continuity of the bowel having been re-established, the operation was rapidly completed and the patient returned to his bed. No amelioration of the symptoms, however, followed. By the middle of the next day the patient had not passed any gas or fecal matter and his general condition was very bad. Another laparotomy was done and an artificial anus established. The intestine was, however, completely paralyzed, and the patient died during the night of septic peritonitis. Autopsy revealed nothing new, but enabled the removal of the anatomical specimen which is preserved in the surgical clinic of the St. Sauveur Hospital.

Jonnesco divides retroperitoneal hernia into four classes: (1) Herniæ through the foramen of Winslow. (2) Herniæ in the retroduodenal fossa. (3) Herniæ in the retrocæcal fossa. (4) Herniæ in the intersigmoid fossa.

The intersigmoid fossa has been carefully described by Toldt. Before the time of Toldt the intersigmoid fossa was believed to be situated between the two folds of the mesocolon of the sigmoid flexure,—while in reality, as shown by Toldt, this is very rarely the case, it being usually situated between the parietal peritoneum and the mesocolon. According to Lambret, the orifice of the fossa is best seen by lifting the

sigmoid flexure upwards and to the right to a level with the internal border of the psoas muscle, not far from the sacro-iliac synchondrosis and the bifurcation of the common iliac artery. In Lambret'*s case the falsiform fold was found over the orifice.

In the cases thus far observed, the cavity of the fossa has been of variable length, from 3 to 10 cm., in some cases reaching as far as the level of the pancreas. The shape of the cavity varied according to the intestinal contents, to which it always adapts itself. The origin of this fossa has been explained in various ways. Toldt and Jonnesco believe that it is dependent in a large measure upon the influence of the arteries of the mesosigmoid. Lambret believes that the intersigmoid fossa is the result of a particular mode of development of the peritoneum and the folds comprising the mesosigmoid. In brief, he believes that the fossa is due to an interruption in the process of fusion of the mesocolon, the fusion with the parietal peritoneum taking place at a point lower than normal. He believes that the fossa is present in about 80 per cent. of the cases, its protected situation being responsible for the very small number of herniæ that occur in this region.

II. INTRAPARIETAL VENTRAL HERNIA AT MCBURNEY'S POINT.

Mr. X., aged 53 years, had a left inguinal hernia since childhood. Four years ago, his horse fell during a polo match and rolled upon him, injuring the right side of his abdomen. Not very long after this he began to have pains in the region of the right iliac fossa which, it was thought, might be due to some trouble with the appendix.

I first saw the patient in consultation with Dr. W. L. Culbert of New York, in October, 1905. Physical examination at that time showed an oblique irreducible omental scrotal hernia on the left side, and on the right side a direct inguinal hernia about the size of an egg. No tenderness or resistance could be detected over the appendix, and it was believed that the pain and discomfort in the iliac fossa was probably due to the direct hernia which had not been hitherto discovered.

In the latter part of October, 1908, I operated for the double hernia, resected a portion of the omentum on the left side and found a direct hernia of the bladder on the right side. Both wounds were closed by Bassini's method; primary union followed and although the patient has led a very active life, riding and playing polo, there has been no recurrence up to the present time.

Immediately after his recovery from the operation, he stated that he felt the same pain and discomfort in the right iliac fossa in the region of McBurney's point that he had had before the operation. The trouble was always worse in the latter part of the day, after standing or being on his feet a good deal, and seemed to be relieved by pressure with the hand. I made a number of examinations, but was never able to detect any tenderness or other indications pointing to an inflammation of the vermiform appendix, although the patient localized his pain and discomfort exactly in the region of the appendix. The trouble gradually became more and more annoying and in November, 1908, I made another very careful examination. During this last examination I made the patient cough several times with my fingers pressing directly over the appendix and I then, for the first time, detected a swelling or tumor, apparently beneath the aponeurosis of the external oblique. On pressure the swelling disappeared with exactly the sensation that a hernial tumor gives when its contents slip back into the abdomen under pressure of the finger. The swelling could be made to reappear with the patient's coughing and gave the same sensation on deep pressure. The aponeurosis was apparently normal. Hence the most rational explanation of the phenomenon was that there was an opening through the transversalis fascia and internal oblique muscle of sufficient size to permit the hernial sac to protrude until it reached the aponeurosis of the external oblique. I, therefore, made the diagnosis of interstitial hernia at this point. This diagnosis explained perfectly the pain and discomfort which the patient had so long had in this region and also the gurgling sensations which he stated he had felt from time to time when pressing upon the abdomen in an effort to relieve the discomfort. I advised operation as soon as convenient to the patient. A consultation was first held with three other men. Two of these men were inclined to attribute the condition to intra-abdominal

adhesions, while the third thought it was due to a retroperitoneal lipoma rather than a hernia, but all advised operation. I operated upon the patient on January 27, 1909. Incision was made exactly as for an appendicitis operation. The aponeurosis of the external oblique was found intact and very firm. On cutting through the aponeurosis, a tumor about the size of a large goose egg was found. It was of yellowish color, and the outer layer, about one-fourth inch in thickness, consisted of extraperitoneal fat. On cutting through this, a hernial sac, the size of a large hen's egg, presented itself. This was opened and found to contain a loop of the cæcum, which immediately reentered the hernial sac as soon as it was reduced into the abdomen, showing that it had probably occupied this position most of the time, and when it became filled with gas or other contents, caused the pain and discomfort from which the patient had so long suffered. The neck of the sac was situated almost exactly at McBurney's point and the inner side touched the edge of the rectus muscle; it was about seven-eighths inch in diameter and was surrounded by a firm ring of transversalis fascia.

I believe that the hernia was probably of traumatic origin, that a rent in the transversalis fascia was caused four years before at the polo accident and that the hernial protrusion found its way through this shortly afterward, gradually making its way outward through the fibres of the external oblique muscle until its progress was finally checked by the strong layer of aponeurosis. It then enlarged in all directions until it formed a tumor of the size described. There were no adhesions between cæcum and sac. The sac was entirely removed and the transversalis layer and peritoneum sutured by overlapping. The internal oblique muscle was then closed with interrupted sutures of kangaroo tendon; next the aponeurosis and, finally, the skin.

The patient made an excellent recovery and left the hospital at the end of two weeks and has been perfectly well ever since. He has had no return whatever of any of the old symptoms. The size and anatomical position of the sac are well shown in Fig. 3.

The only case that I have been able to find at all similar to the foregoing is the case of Levy, recently reported in the *Beiträge f. klin. Chir.* In view of the fact that in Levy's case there was an undescended or partially descended testicle, there

FIG. 3.

Interstitial hernia at McBurney's point. Sac containing cæcum. (Coley.)

is reason to believe that we have to deal here with one of the ordinary types of interstitial hernia with a bilocular sac, of congenital origin, entirely unlike the case I have described.

I disagree altogether with the statement of Levy that in the absence of complications the treatment of abdominal herniæ due to muscle defects should be mechanical, *i.e.*, that the patient should be fitted with a suitable abdominal support. I believe that all of these cases can be cured by a suitable operation without any risk to the patient. The fact that these cases are peculiarly liable to strangulation should be sufficient ground for advocating operative treatment as a routine measure.

CASE III. RESECTION OF FOUR FEET OF SMALL INTESTINE FOR RECURRENT ATTACKS OF INTESTINAL OBSTRUCTION FOLLOWING REDUCTION EN MASSE OF A STRANGULATED HERNIA FOUR MONTHS BEFORE.

Mr. Y., 53 years of age; has always been in good health. Operated upon for strangulated hernia (by Dr. Foy of Yonkers) in January, 1909; duration of the strangulation 8 hours. A large loop of small intestine was found very dark in color, but as it partially recovered under hot towels was replaced in the abdomen. The patient did very well until three weeks after operation, when he had a slight attack of intestinal obstruction. Had five or six attacks since, sometimes every five or six days; he went one month without any attack; the last very severe attack occurred on May 8. These attacks always began by a localized distention in the left side, which gradually spreads upwards across the abdomen to the right iliac fossa. Vomiting quickly followed and persisted, becoming almost fecal in character. I saw the patient on May 10; he had a movement of the bowels due to strong purgatives and enemas. The abdomen returned to normal and nothing could be felt on palpation. The patient was somewhat weak from the effects of the attack. I believed the condition to be one of adhesions with constriction of the bowel and areas of sloughing. I advised an operation at as early a date as possible. The patient entered the hospital on May 12, 1909, and I did a

median laparotomy, assisted by Dr. W. E. Downes. I quickly found two separate loops of bowel joined at a sharp angle by a firm band of adhesions about 1 inch in diameter. These adhesions were cut and the raw surfaces turned in with silk suture. I then came upon a mass about the size of two fists, situated in the middle and a little to the right side of the abdomen; it consisted of five or six coils of small intestine so completely welded together that it was difficult in places to make out the outlines of the separate loops of intestine. It was evident that it would be impossible to separate these adhesions and I decided to resect the entire mass and do a lateral anastomosis. A piece of tape was passed through the mesentery and tied around the healthy portion of the bowel, well beyond the point to be divided. The mesentery was clamped off and sutured by means of fine chromicized catgut. The divided ends of the bowel were inverted and sutured in two layers. The portion removed extended nearly to the ileocæcal valve. A lateral anastomosis was made between the ileum and ascending colon by means of a large Murphy button. Inasmuch as the appendix was found to contain a large, very hard concretion and showed some evidence of congestion, it was removed. The abdominal wound was closed without drainage. Time of operation 1 hour, 15 minutes.

The first two days the patient was given a very small quantity of saline per rectum and a small quantity of water by mouth. On the third day he was given chicken broth and albumin water in one-half ounce portions every 2 hours. The amount of nourishment was gradually increased and at the end of the week he was given solid food. He had very little more reaction than follows an ordinary hernia operation. He passed the button on the eleventh day and was up and about the ward at the end of two weeks. The wound healed by primary union.

The condition of the intestine shows that at the time of reduction the bowel must have been reduced *en masse;* the adjacent loops were so much inflamed that they immediately became adherent and finally welded together in the solid mass seen by the mounted specimen presented.

VESICO-INTESTINAL FISTULÆ.*

BY FREDERICK W. PARHAM, M.D.,

AND

JOSEPH HUME, M.D.,

OF NEW ORLEANS, LA.

THE term enterovesical has been employed by many writers, but we have discarded it, because of hybrid Greek and Latin origin, and have adopted the etymologically more correct designation, vesico-intestinal fistulæ, as the title of this paper.

This is a comprehensive term, including all cases where a communication, direct or indirect, exists between the bladder and any portion of the intestinal lumen from pyloric orifice above to anus below. Appendiculovesical fistulæ have not been excluded from this consideration, but no thorough search of the literature has been made for this variety of communication. Some sixty odd cases are, perhaps, to be found scattered through the literature, many of which have not been available for the purpose of this communication. Some are so closely related to the cases under discussion that they have been utilized to illustrate certain phases of the subject.

The literature of vesico-intestinal fistulæ has been quite meager and, with the exception of a few articles, almost inaccessible to English readers. The materials for this paper have been drawn chiefly from Harrison Cripps, who wrote a monograph in 1888, based on 63 cases; Chavannaz, who published an excellent statistical study in 1897 of 95 cases; Kelly and MacCallum, on "Pneumaturia" in 1898; and Pascal, who published his "Doctorate Thesis" in 1900 on "Acquired Vesico-Intestinal Fistulæ," in which he brings the

* Read before the American Surgical Association, June 5, 1909.

number up to 346 cases, including those of Cripps, Chavannaz and others collected from many sources. To these should be added the interesting case of Jewett's, referred to in Kelly and MacCallum's article.

We have searched the literature for cases appearing since 1900 and, as will be seen by the table appended, have added 38 cases, making the total 385 cases to date, including our own, a few conveyed in personal communication, and six cases found in an article by W. Sachs,* of Mullhausen, published in December, 1908.

From the earliest times there are occasional references to communications between intestine and bladder, but the condition was not at all carefully studied until about 1800. The first attempt at collecting and classifying the reported cases appears to have been made by Blanquinque in 1870.

The older writers considered the condition beyond the reach of the art and the first suggestion as to a rational treatment seems to have been made by Barbier de Melle, who, in 1843, believing the site of the fistula always to be in the cæcum, proposed colotomy as a means of cure. Pennell in 1850, and Curling in 1852, were the first to put this procedure into practice, but up to 1870 only six colostomies had been done for vesico-intestinal fistulæ. Pascal claims this as an essentially French operation, but admits that it obtained its greatest success in England.

In 1871 Simon operated on two cases of rectovesical fistulæ, sectioning the sphincter and making a direct suture of the rectal orifice; once with success. Billroth in the same year operated by the same method, but failed to relieve the patient. His observation was not published until 1879.

Dumenil, reporting a case before the French Surgical Congress at Rouen in 1884, highly extolled colostomy, and its popularization as a means of relief of this distressing malady is probably due largely to him.

These two operative principles combined—colostomy and later section of sphincter with suture of fistula—have since

* Deutsche Ztschrft. f. Chir., Dec., 1908.

been the chief methods for attacking rectovesical fistulæ, until rather recent times.

Le Dentu, in 1884, before the Society of Surgery in Paris, suggested suprapubic cystotomy followed by intravesical suture of the bladder opening. This was carried out by Pousson in 1895, with temporary success but ultimate failure, and, as was to be expected, this plan has had few followers. Kelly and MacCallum in 1898, and Reginald Harrison in 1895, enumerate this among the surgical procedures, and one of us in 1897 in a case reported here did the same thing unsuccessfully.

In 1887, Czerny did the first laparotomy, but his patient died. The third and first successful one was done by Boiffin in 1891. Since then the principles of modern abdominal surgery have been freely utilized in such conditions. Cripps, however, writing in 1888 on a basis of 63 cases, takes a gloomy view of the prognosis and is in favor of colostomy rather than laparotomy—or rectal suture.

The best etiological classification seems to be:

- Unknown
- Traumatic
  - Accidental
  - Surgical
- Non-Traumatic
  - Inflammatory, including
    - Abscess
    - Stricture
    - Stone
    - Ulcer
  - Malignant
  - Tuberculosis
  - Syphilis
  - Actinomycosis

Many of the cases, especially the older ones, are so vague that the cause cannot be determined.

The traumatic fistulæ fall into two categories; accidental, by gunshot and stab wounds, falling on stakes, etc., of which the majority are caused by gunshot wounds; and surgical, following the lateral operation for stone, puncture of bladder by rectum, etc. Many such accidents must have followed surgical intervention in former days, but doubtless were not reported.

As a rule fistulæ due to traumatism are developed promptly, but in a minority of the cases they have followed secondarily, either owing to inflammatory action or to the irritation produced by a retained foreign body, bone, etc.

Again, spontaneous cure often follows traumatic fistulæ. Inflammation, cancer and tuberculosis are responsible for the greater number of non-traumatic fistulæ. Rarely one finds actinomycosis or syphilis as the cause.

Pascal, in his Thesis of 1900, gives the following table of non-traumatic cases, classified in this manner:

	Per cent.	No. of cases.
1. Origin in bladder, prostate, vesicles....	18	54
2. Origin in intestine.....	35	105
3. Origin in vicinity of bladder.....	16	48

It is impossible to do more than to give a general picture of the various changes met with at autopsy. The usual findings are those of chronic localized peritonitis, dense adhesions between intestines and intestines and bladder, and masses of indurated thickened tissue, in which may be found cavities containing pus and fæces; to which are added the special features of the causative agent—tuberculosis or neoplasm. Occasionally one finds a simple fistulous tract separating gut and bladder, or again a distinct purulent pouch, into which bladder and intestine empty—the "foyer intermédiare" of Chavannaz.

The bladder is usually contracted, very rarely dilated. Its inner surface, in addition to the abnormal orifice, presents the lesions of chronic cystitis with varied changes in mucous membrane and musculature. Pascal, under the influence of the French school, seems to think that cystitis is not constant, and secondary ascending infection rare. But from the history of the cases and those that we have seen, cystitis seems to be a constant concomitant in some degree, and out of 25 autopsies in which the condition of the kidneys was stated, 18 times they were diseased, and of these 15 were bilateral infections. Of these 18 cases, 6 were due to cancer, 3 to tuberculosis, and 9 to inflammatory processes. Kelly and

MacCallum state that renal symptoms are comparatively rare considering the state of the bladder.

The symptoms are naturally divided into those associated with the primitive lesion, and those dependent upon the fistulous condition. One is struck by the remarkable similarity in the clinical course of the collected cases. One follows another presenting practically the same phenomena, and only differing in causation and unimportant detail.

In the non-traumatic cases there is an antecedent history of intestinal or urinary disease, which ends either abruptly or insidiously by the passage of fecal matter and gas per urethram or liquid stools. As a generality the onset is insidious. Indeed, it is often a distinct surprise to the patient when he suddenly passes gas or fæces. Often the condition is only discovered accidentally, and rarely, though it has been so recorded, one is unaware of this condition.

Once the fistula established there is usually a period of calm, transient or prolonged, then vesical infection ensues and frequent, painful, perhaps, difficult, urination torment the unfortunate. With this there is much mental anxiety and perturbation; digestive troubles, malaise, deterioration in health progressively until the end which comes through general infection or the advancement of the original disease, be it carcinoma or tuberculosis.

Rarely, the patient experiences no discomfort, suffers no impairment of health and lives his life in spite of his condition.

When seen by the physician the prominent symptoms are the passage of gas or fæces per urethram, or liquid uriniferous stools and vesical or rectal disturbances: these suffice to characterize the malady.

It is impossible to read the monographs of Cripps, Chavannaz and Pascal, or to consider the outcome of the collected cases without realizing the gravity of this affection.

In 81 cases which Pascal analyzed he found the mean duration of life, after the appearance of the fistula, to be three years. He also states that out of 300 cases only 19 recovered spontaneously, 15 recovered under expectant treatment, and 24 were cured by operative measures.

Fistulæ situated in the small intestine are unfavorable, as nutrition is interfered with. Those, whose orifices are guarded by papillæ or valves, offer a longer life, as the bladder is partially protected from constant inroads of fecal matter. The amount of disturbance depends largely upon the size of the communicating opening, small perforations oftentimes causing little discomfort. If the urine is passed per rectum rather than fæces per urethram the outlook is much better; and finally any obstruction to urination materially increases the danger as it favors renal infection.

Cancer and tuberculosis appear to be uniformly fatal, when causative agents of this condition.

The complications usually met with are of inflammatory origin or due to secondary calculus deposits in bladder.

While the prognosis is always serious, surgery offers a large hope that the future will see a greatly lessened mortality.

It would seem, at first glance, that the diagnosis of intestinovesical fistula would be easy, but in practice many cases are overlooked at first. The diagnosis to be complete must explain (1) the condition; (2) the cause; (3) the location of the fistula, (*a*) in bladder, (*b*) in intestine; (4) the mode of communication between the viscera, direct or indirect.

The differential diagnosis lies between (1) intestinovesical fistulæ; (2) uretero-intestinal fistulæ; (3) reno-intestinal fistulæ; (4) urethrorectal fistulæ; (5) pneumaturia.

In general, the passage of gas and fecal material by the urethra or liquid uriniferous stools, coupled with the finding of vegetable or animal tissue in the urine, complete the gross picture. Communication between the renal pelvis and intestine, or between ureter and intestine is to be made out by cystoscopic examination, showing (1) Absence of abnormal opening in bladder wall. (2) Seeing cloudy, and especially, fecal urine escaping from an ureteral orifice. (3) Catheterization of the ureters in every case of doubt. Segregation will be of use, but is unreliable, as an opening on one side of bladder might be confused with fecal flow into bladder through the ureter. The cause must be determined by the

history, physical examination, tuberculin reaction, examination of urine, etc. Confirmations may be had by the administration of bismuth or charcoal by mouth and their appearance in the urine.

A few words must be said on the question of gas passing per urethram. There are conditions, other than intestino-vesical fistulæ, in which this phenomenon occurs: (1) After instrumental vesical manipulation, litholapaxy, etc. (2) In certain neuropathic conditions. (3) In glycosuric conditions.* These excluded, the passage of gas through the urethra is pathognomonic.

In the bladder the perforation is usually single, occasionally double, very rarely multiple. It is usually small. The position varies, but in almost one-half the cases the abnormal orifice is formed on the base or posterior wall. The summit is the next most frequent position, and only exceptionally the anterior wall. But the location in the intestine is even more important and more difficult to decide on. The site of the opening determines to a great extent the operative measures for relief. Keen's case well illustrates the difficulties attending the definite location of the position of the fistula. The position of the fistula may be ascertained by (1) Cystoscopy. (2) Proctoscopy with digital exploration of rectum. (3) Introduction of plain, colored, or chemical solution or gases via bladder or rectum and their recovery from the opposite organ. (4) Character of food material in urine, as regards the stage of digestion. The elements of the food could be distinguished in Jewett's case indicating location near stomach, afterwards confirmed. By these means the gut can be explored as high as the sigmoid and the bladder in totality. If one is unable to locate the intestinal position of the fistula by these methods, there only remain conjecture and exploratory laparotomy.

* In Kelly and MacCallum's article on "Pneumaturia," this subject is very thoroughly discussed. Heurry Fenwick also considers it at some length in his work on "Clinical Cystoscopy." See also Dumenil, Rev. de Chir., p. 241; Guignard Jour. des mal. des org. gen., 1883, p. 242.

Chavannaz gives the following percentages indicating the location of the fistulæ: Rectum, 44.44; sigmoid, 24.07; colon, 11.11; colon and ileum, 7.40; appendix, 1.85.

The treatment is either medical or surgical.

Medical: Including rectal and vesical irrigation, local treatment of fistula where possible by curettage and cauterization, urinary and intestinal antisepsis, specific medication, and all measures of general hygiene. Under such regime a certain proportion of cases have recovered; 36 out of 58 recoveries recorded by Pascal.

Surgical treatment may be either palliative or curative. The palliative measures are directed toward the amelioration of the distressing secondary symptoms resulting from stone, stricture, etc. While not designed to cure, this sometimes results in a relief of the condition. The extraction of a stone by lithotomy or lithotrity, the dilating of strictures in a few instances have been followed by healing of a fistula. Under this head may also be placed colostomy, intestino-anastomosis and lumbar transplantation of the ureters. When colostomy is decided upon it is necessary that it should be done so as to fulfil two conditions. First, it must be above the fistula; second, it must be complete, so as to have no connection between the upper and lower segments of the intestine. Moreover, the upper end of the lower segment must be left open and frequent irrigation through and through this segment must be practiced. Ballance lost two cases by closing the lower segment, and Madelung lost two cases where he closed the inferior end and dropped it into the cavity.

Intestino-anastomosis as first practiced by Boiffin and the procedure of Wassilief, or its modification suggested by Lardennois with the Murphy button might be considered in certain rare cases. This procedure of intestino-anastomosis has resulted in cure in a few cases. Intestinorectostomy, intraperitoneal, may be done 7 cm. above the sphincter.

Curative Treatment: Radical treatment has for its object separation of the abnormal openings between intestine and bladder and the restoration of their lumina by separate closure

of the openings. The operative approach may be made via (1) the rectum, (2) the perineum, (3) the sacrum, (4) the bladder, (5) the abdomen, or by combination of two or more of these methods. Rectovesical fistula situated within 4½ inches of the anal orifice may be best attacked by one of the perineal operations. This will usually be better than operating through the rectum. The operations of Marion Sims, Desault and others, through the rectum have given good results, and for certain fistulæ low down, are, perhaps to be preferred with, or without, section of the sphincter, primary or secondary. Perineal incision of Zuckerkandl is to be preferred to that of Simon as giving better access. If the suture is made in several layers, the last being of catgut, as suggested by Hugh Young, with suprapubic bladder drainage there will be good chance of success. The anterior transpelvic procedures of Langenbeck, Niehans and Helferich, Ollier and Chalot, are exceptional and will scarcely ever be necessary for closure of these fistulæ. Posterior transpelvic, or sacral operations, however, must be seriously considered in some of these rectovesical fistulæ situated too high for the rectoperineal operation. Of these we should give the preference to the osteoplastic resection. Where more than the coccyx is to be removed the best type of this operation is the Rehn-Rydigier. The transvesical, or intravesical operation suggested by Le Dentu is hardly to be recommended. Only one case, that of Duplay, Case 332, was successful. In one of the cases reported by us it was tried with only temporary success. In another case, that of Fowler, (Case 316), the bladder was merely opened suprapubically and drained, but no attempt was made to suture the fistulous opening in the bladder. Cure followed this simple procedure. All the others, Cases 304, 310, 329, 333, 334, 335, and our own, 378, were either absolute failures or only temporary successes.

Finally the intraperitoneal or transperitoneal operations are to be considered. One of these procedures is to be recommended in all cases where the milder operations have been either tried or are clearly inapplicable. Exploratory laparotomy often affords the only reliable means of informing one's

self thoroughly as to the true condition and its cause, and enables the surgeon to decide upon the best procedure from actual observation. Then, too, if nothing can be done, it may be easily terminated by the palliative operation of colostomy. If the point of adhesion or communication can be found and separated, the radical operation is the procedure of choice. In some cases it may be advisable to close only the intestinal opening, draining the intermediary pouch, or sometimes a simple drain may be put in, without closure of either opening. One case is reported cured in this way. (Terrier, Case 301.) If the adhesions are such as to make it impracticable to separate the viscera, the radical operation may have to be abandoned and intestino-anastomosis, or bilateral exclusion of the involved intestinal loop, or colostomy done as a last resort.

Sachs, in *Deutsche Zeitschrift für Chir.*, December, 1908, reports a case in which he successfully operated by excluding totally the portion of involved intestine, 15 cm. in length, turning in both ends of this, and re-establishing the intestinal continuity by end-to-end approximation with Murphy button. This procedure, the suggestion of which he credits to Salzer * has been carried out in only one other case, that of Eiselsberg (Case 384) which died five days after operation. While so brilliantly successful as in Sachs' case, it nevertheless is open to such serious objection that we must agree with Payr in asking yet more light upon the later course of cases so treated, before we can give it our unreserved endorsement. It is true that cases like those of Bryant and Harrison, in which autopsy some years subsequent to a colostomy for rectovesical fistula showed complete obliteration of all that part below the artificial anus, afford justification for the operation of complete intestinal exclusion as done by Sachs, but, as he points out, we cannot always be sure that urine or natural secretion in the excluded section may not accumulate and furnish a positive menace to life. Where the communication is with the lower part of colon, sigmoid or rectum, the flow of urine into the bowel is made evident by its escape from the anus;

* "Festschrift Billroth," p. 536.

in such cases one would hesitate to resort to this operation of complete intestinal exclusion. Further, in cases of high intestinal involvement one may never be sure that there is no flow of urine from bladder to intestine, because even where it does occur it may be absorbed or be so mixed with fæces as not to be apparent in the stools. It would seem, then, until further investigation is made, that complete intestinal exclusion should only be carried out in those cases where we may be reasonably sure that the flow is only in the direction of the bladder, not from it into intestine. We think, with Sachs, that this problem calls for experimental investigation in animals to determine in how far bilateral, or complete, intestinal exclusion may be considered a safe surgical procedure.

CONCLUSIONS:

1. Establish clearly the nature of the lesion.

2. Determine the location of the opening in the bladder and in the intestine, when possible; this can usually be done by the modern methods of exploration of the rectum and bladder, and by a study of the intestinal contents passed per urethram.

3. Medical treatment is always to be tried for a reasonable time, as some cases have recovered under such management, and certain fistulæ of syphilitic origin have been absolutely cured by appropriate treatment.

4. The prognosis of cases untreated is generally bad and spontaneous cures are rare.

5. Ascending infection of the kidneys is one of the most important sequellæ, and this is always to be feared in cases that do not recover within a reasonable time.

6. Colostomy relieves the symptoms though it does not cure the condition, but is to be tried in all cases where a radical procedure is not possible.

7. Radical operation is always to be preferred when practicable; from below, when the fistula is situated within 4½ inches of the sphincter in suitable cases; intraperitoneally, for high-placed fistulæ, the viscera being separated and direct suture of each opening done.

8. Where the radical operation cannot be done, bilateral

or total exclusion of the portion of intestine involved, as practiced by Sachs in Case 385, may be done when there is no urinary flow into the bowel; this not being advisable, one of the shunting anastomosis procedures should be done, or simple drainage of an intermediary pouch resorted to.

9. The suprapubic intravesical suture of the bladder orifice is not to be recommended, because difficult of execution and uncertain in result.

10. Exploratory laparotomy is indicated in all cases in doubt to determine the location of the fistula and the operation of choice. Colostomy is to be regarded as an operation of last resort and applicable only in those cases where the artificial anus may with certainty be placed above the fistulous communication with the bladder.

DR. PARHAM'S CASE OF *Vesicorectal Fistula.*

J. L., 48 years of age, a native of Louisiana, consulted me in 1895, complaining of great irritability of bladder due to the passing of fecal matter.

Family history: Father died of pneumonia at the age of 52, mother died at age of 27, shortly after his birth. Both grandfathers died about the age of 60. Does not know anything of grandmother. One sister and two brothers are living and in good health, one half brother by father died of lung trouble at age of 36, one sister died at 52 years of heart trouble, two half sisters of yellow fever.

Personal history: Has been much afflicted with fevers since childhood, periodical in character. In 1889 had severe jaundice with stomach trouble. Had measles and whooping cough when a child. No history of chronic cough. Twenty-five years ago had severe dysentery lasting a month.

History of present disease: In October, 1892, suffered with constipation and pains in lower part of abdomen on left side, accompanied by frequent micturition, followed after each urination by burning sensation in the urethra. This continued about three weeks, when he took 10 grains of calomel followed by Epsom salts. Violent pains in lower abdomen attended the purgative action. In November, 1892, being still much troubled, he came to New Orleans and was treated by Dr. Chassaignac for two months. He thinks he passed some bowel contents occa-

sionally by urethra during this time, attended by much bladder disturbance. He went home much improved. Four months later he was so much better he was able to resume his duties as road and levee inspector in his country district, although he would have at times more or less bowel and bladder disturbance.

In November, 1893, he had an attack of dysentery, and was much worse with his urinary troubles. He came to New Orleans and was again under Dr. Chassaignac's care for three weeks. Under this treatment he improved and was well as before. He thinks he passed occasionally some fecal matter. After this, he continued to improve, the symptoms all disappearing except the frequent urination. He got much stronger and would have considered himself well, but for the occasional pains in the lower abdomen on the left side. He seems to have remained well for a long time after this, but in June, 1895, he became ill again with fever, colic in the lower abdomen, left side especially, followed some hours later by the passage of gas and fecal matter per urethram. He entered the Charity Hospital and was treated by Dr. Brickell for four weeks. Under treatment he improved very much. He would frequently urinate fecal matter. During constipation he would not pass fecal matter by urine for sometimes three or four days. He went home in June, 1895. In November, the symptoms of his old malady returned in aggravated form, preceded by diarrhœa. Fecal matter came now in increased quantity with the urine. This condition of things continued until his admission to my service at the Charity Hospital on November 18, 1895. His condition at this time was as follows:

Has lost much flesh, though not emaciated. General appearance good, complexion clear with slight conjunctival injection and some jaundice. Tongue fissured and slightly coated. Has good appetite and would sleep well were he not disturbed by frequent urination. Temperature, pulse and respiration normal.

Examination of abdomen, rectum and urinary organs: Somewhat constipated but consistence of passages normal. Has had no diarrhœa since his admission. Belly-wall loose and not retracted. Nothing revealed by palpation, except slight tenderness over region of bladder. In left inguinal region nothing, but in right inguinal region a reducible scrotal hernia. On standing right side of scrotum filled well with the descended bowel.

History of this hernia: Has been present as long as he can

recollect. Always suffered more or less, but never wore a truss until 1883, when one gave him considerable relief. In November, 1893, the truss being old had to be drawn very tight, but he is not sure that this had anything to do with the pains which came on in the lower abdomen.

November 30, 1895: Filled bladder with sterilized fuchsin solution; none came into rectum. Then emptied bladder and filled with uncolored fluid and threw methyl blue solution into rectum and allowed the bladder to empty through a catheter introduced, the patient being in knee-elbow position. No bluish coloring of the water was observed. Digital examination of rectum revealed moderately enlarged prostate, tender. Several hours afterwards a chill followed by fever to 103 degrees.

December 6: Is passing fecal matter freely, fecal odor, no undigested particles. Bowels have been somewhat disturbed during the night.

December 29: Assisted by Drs. Chassaignac, Matas, Martin and Delaup, I opened the abdomen in the middle line below the umbilicus. The upper part of the rectum and lower part of the sigmoid was adherent on the bladder wall. A large, hard mass could be felt here. We concluded it was an inoperable neoplasm and closed the abdomen.

January 13, 1896: Fecal matter is passing in increased quantity.

February 4, 1896: The condition being aggravated and radical operation being out of the question, I did an inguinal colostomy in two stages, the second stage being completed by the formation of the artificial anus three days later. The section of bowel was complete.

February 9, 1896: The stitches were all removed and the anus was well established. The lower segment of bowel was irrigated daily. Amelioration of the bladder symptoms was prompt and decided.

February 17, 1898: I determined now to make an effort to close the bladder opening and, if successful, to restore the continuity of bowel, where broken by the artificial anus.

Accordingly, on February 17, 1898, at the New Orleans Sanitarium, I opened the bladder above the pubic symphysis. I found the opening without much difficulty on the superior wall and sutured it with catgut, inserting four sutures. Dawbarn's intermittent siphonage was employed to protect the line of suturing.

(In another case I should use a de Pezzer catheter per urethram.) For a time it seemed that we would succeed, but the sutures gave way and the opening became re-established. The suprapubic wound gradually healed and he was allowed to go back to his home in the country, no further effort being made to close the bladder fistula.

I have not seen him now for many years but have occasional letters from him. He wrote me during May of last year, reporting himself as comfortable and enjoying good health. The artificial anus is easily managed, giving him little inconvenience except when bowels are loose.*

Dr. Hume's Case. Mr. H. H., M. W., aged 39 years, married; has 5 children. Jan. 22, 1908: complaint, pus in urine and bladder trouble.

Family history: Two uncles, paternal, died of T. B. Past history: Mumps as a child, no orchitis. Malaria, no hæmaturia with it. Some inflammation of bowels 10 years ago. Does not know what it was; some thought it appendicitis; was in bed one month. General health good; constipated; average weight 153 pounds; 8 to 10 pounds below it now. Venereal history. Soft sore 20 years ago; no secondaries. Denies gonorrhœa.

Present illness: Patient well till one year ago. Then, when in a malarial attack, his urine was examined and pus was found in it, also albumin. Since then seen by several doctors who considered he had kidney trouble, probably tuberculosis. Patient has no symptoms save from frequency of urination and a "sputtering," as if air was in his urine, on urination. Every two to four weeks he gets depressed, feels drowsy, occasionally has chill with fever. Has pain in back low down in middle of spine. He is then sick with fever for a few days, and his urine seems worse at such times. He has had these attacks for twenty years, five or six a year at first, later every two to six weeks. Duration one to eight days. Considered as malarial or bilious attacks and treated by purging.

Examination.—Patient, well-built male; prematurely gray and aged to eye. Tongue furred. Thorax negative, abdomen negative save for slight pain in (1) left iliac fossa, (2) right

* It is not infrequently true that a mass suspected after abdomen is open to be malignant, is proven, as in this case, by the lapse of time to be merely inflammatory infiltration (see also Mayo's article on Diverticulitis).

TABLE OF CASES

u x r = Urine by rectum. rf = Either or both ways. 2 I = Two orifices in intestine.
f x u = Fæces by urethra. F. I. = Foyce intermédiare. 2 B = Two orifices in bladder.
A. = Autopsy.

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
1	M	.....	.....	u x r	.....	.....	12 yrs.
2	M	Cancer of rectum	Rectum and bladder-neck. 1	f x u	.....	Autopsy	
3	M 12	.....	.....	u x r	.....	Recovery	
4	M 80	Cancer of bladder	Rectum and bladder. 1	f x u	Medical	Death	3 mos.
5	F	Traumatic	.....	u x r	.....	.....	.....
6	M 50	Cutting for stone	Rectum and bladder. 1	u x r	Medical	A., cancer of Bladder	.....
7	M	.....	.....	u x r	.....	Recovery	.....
8	M	.....	.....	f x u	.....	A., ulceration of bladder	.....
9	M	.....	.....	u x r	.....	A., cancer of bladder-neck	.....
10	M	.....	Bladder and rectum	u x r	.....	A., ulceration found	.....
11	M	Stone (?)	.....	f x u	.....	.....	.....
12	M	Gonorrhœa (?)	Rectum and bladder	u x r	Medical	Failure	.....
13	M 50	Stone	.....	f x u	.....	Death	6 mos.
14	M	.....	Colon and bladder	f x u	.....	A., abscess in left iliac fossa	.....
15	M 60	Stone	(Kidneys diseased)	f x u	.....	Autopsy	.....
16	M 7	Traumatic	.....	u x r	Medical	Recovery	.....
17	M 69	Stone	Rectum and bladder	u x r	Medical	Death	.....
18	M 50	Cancer (?)	.....	u x r	.....	A., rectum not examined	.....
19	M	.....	.....	u x r	.....	Death	.....
20	M	Ulceration	Rectum and bladder	u x r	.....	.....	.....
21	M	.....	.....	f x u	.....	Death	.....
22	M 50	.....	.....	u x r	.....	Death	.....

23	M 73	Stricture of sigmoid	Colon and bladder F. I. (Kidneys diseased.)	f x u	Medical	Autopsy	.....
24	F	Cancer (?)	.....	rf	.....	Death	3 mos.
25	M 60	.....	Colon and bladder	f x u	.....	Autopsy	8 mos.
26	.....	Stone (?)	.....	u x r	.....	Recovery (?)	.....
27	M 63	Ulcer of rectum	.....	u x r	.....	.....	.....
28	M 62	Stricture (?)	Ileum and bladder	f x u	.....	Autopsy	1 mo.
29	M 60	Traumatic. Puncture of bladder by rectum	Rectum and bladder	u x r	.....	.....	10 yrs.
30	M	Traumatic. Puncture of bladder by rectum	.....	u x r	.....	A., Suppurated	11 da.
31	M 50	Stricture of rectum	.....	f x u	.....	Death	5 mos.
32	M 50	Abscess between bladder and rectum	.....	f x u	Medical	Recovery	.....
33	F 24	Inflammation	Sigmoid and bladder. F.I	f x u	.....	Autopsy	1 mo.
34	M 6	Cutting for stone	.....	u x r	.....	Not cured	.....
35	M 14	Cutting for stone	.....	u x r	.....	Death, peritonitis	6 da.
36	M 16	Gun shot. Traumatic	Rectum and bladder	u x r	.....	.....	30 da.
37	M 60	Cancer (?)	Colon and bladder	f x u	.....	Autopsy	.....
38	F 59	Stricture	Sigmoid and bladder	f x u	.....	Autopsy	5 mos.
39	M 53	Inflammatory	Rectum and bladder	u x r	.....	Autopsy	.....
40	M 76	Inflammatory	Sigmoid and bladder F. I.	rf	.....	Autopsy	1 mo.
41	F 27	Child-birth. Inflammatory	Rectum and bladder	f x u	.....	Autopsy	3 mos.
42	F 19	Child-birth	Rectum and bladder	.....	.....	.....	.....
43	M	Tubercular (?)	Colon and bladder. F. I.	f x u	.....	Autopsy	2½ mos
44	M 60	Cancer	Colon and bladder	f x u	.....	Autopsy	4 yrs.
45	M 60	Inflammatory	Rectum and bladder	u x r	Medical	Recovery, cured	2 mos.
46	F	Cancer	Rectum and bladder	f x u	.....	Autopsy	.....
47	.....	.....	Rectum and bladder	f x u	.....	.....	.....
48	.....	Stone	Rectum and bladder	.....	.....	.....	.....
49	M 65	Cancer	Sigmoid and bladder	f x u	.....	Death	.....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
50	M 7	Stone (?)	Ap. and bladder. 2B. (Kidneys diseased).	f x u	.....	Death	8 mos.
51	F 65	Cancer	Ileum and bladder	f x u	.....	Death	4 yrs.
52	F 42	Syphilis	Rectum and bladder	u x r	.....	Autopsy	.....
53	Child	.....	Rectum and bladder	u x r	.....	.....	.....
54	.....	Stricture	Rectum and bladder	f x u	.....	.....	.....
55	.....	.....	.....	f x u	Colotomy	Lived 5 months	.....
56	F 68	Ileum and bladder	.....	f x u	.....	Death	.....
57	M 62	Stricture	Colon, rectum, ileum, and bladder	f x u	.....	Autopsy	.....
58	.....	Stricture of sigmoid	Colon and bladder	.....	.....	.....	.....
59	M 38	Traumatic	Rectum and bladder	f x u	Medical	Autopsy	17 da.
60	M 50	Puncture of bladder	Rectum and bladder	u x r	Medical	Improvement	.....
61	M 64	Traumatic	Jejunum and bladder (Kidneys diseased?)	.....	.....	Autopsy	.....
62	.....	Abscess	Rectum and bladder	.....	.....	.....	.....
63	F 23	.....	Rectum and bladder	f x u	.....	Death	.....
64	F	Abscess of ovary (?)	Sigmoid and bladder. F.I. (Stone in kidney.)	!	.....	Death	.....
65	F 35	Inflammatory	Appendix, cæcum and bladder. F. I.	f x u	.....	Autopsy	.....
66	M 40	Inflammatory	Colon and bladder	f x u	.....	Autopsy	6 mos.
67	F	.....	Colon and bladder. 2 I. F. I.	.....	.....	.....	3 wks.
68	F 54	.....	Bladder, sigmoid and ileum	rf	.....	Autopsy	3 yrs.
69	F	Child-birth	Rectum and bladder	f x u	.....	Autopsy	.....
70	.....	Cancer of cæcum	Cæcum and bladder		.....	Autopsy	.....
71	.....	Tuberculosis (?)	Sigmoid and bladder	f x u	.....	Autopsy	.....

72	M	Inflammatory	Rectum and bladder. (Kidneys diseased.)	.....	.....	.....	.....
73	M 25	Stricture of rectum	Rectum and bladder	f x u	.....	Autopsy	2 yrs.
74	F 45	.....	.....	f x u	.....	Improved	.....
75	M	.....	.....	f x u	.....	Improved	.....
76	M 64	Stricture of sigmoid	Sigmoid in bladder	f x u	.....	Death	.....
77	M	Stone (?)	.....	rf	.....	Improved	.....
78	M	Urethral stricture	.....	f x u	.....	.....	.....
79	M 79	Stricture of urethra (?)	.....	f x u	.....	Death	1 mo.
80	M 44	T. B. of prostate and stricture of urethra	Rectum and bladder. 2 B. (Kidneys diseased)	u x r	.....	Autopsy	.....
81	F 18	Inflammatory	Cæcum and bladder. F.I.	f x u	.....	Autopsy	.....
82	M 37	.....	.....	f x u	.....	.....	.....
83	M 33	Tuberculosis	.....	f x u	.....	Death	.....
84	M 56	Stricture of sigmoid	Sigmoid and bladder. F.I	f x u	operation, colotomy	Autopsy after operation	17 da.
85	F	Inflammatory	.....	f x u	.....	Recovery	.....
86	33	Tuberculosis (?)	.....	f x u	.....	.....	.....
87	59	Abscess	Large intestine and bladder	f x u	.....	Autopsy	.....
88	F 20	.....	.....	u x r	.....	Recovery	.....
89	F 43	Abscess	Ileum and bladder. (Kidneys congested)	f x u	.....	Autopsy	2 mos.
90	56	.....	Rectum and bladder	f x u	.....	Death	5 mos.
91	M 35	.....	.....	f x u	.....	Death	14 yrs.
92	.....	.....	.....	.....	.....	Death	.....
93	54	Cancer of rectum	Rectum and bladder	f x u	.....	Autopsy	2 wks.
94	M	Tuberculosis	Cæcum and bladder. 2B.	f x u	.....	Autopsy	6 wks.
95	M old	Obstruction	.....	f x u	.....	Death	22 yrs.
96	F 48	Inflammatory and tubercular	Cæcum and bladder. F. I. (Right kidney diseased.)	f x u	.....	Autopsy	.....
97	F 28	Cancer (?)	Large intestine and bladder	rf	.....	.....	.....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
98	M 43	Abscess	Cæcum, ileum and bladder. F. I.	f x u	.....	Autopsy	.....
99	M 60	.....	Appendix and bladder	f x u	.....	Autopsy	.....
100	M 42	Syphilis (?)	Rectum and bladder	.....	.....	.....	.....
101	M 3½	Cutting for stone	.....	.....	.....	Recovery	10 da.
102	M	.....	.....	f x u	.....	.....	.....
103	F	.....	.....	.....	.....	.....	.....
104	F	.....	.....	f x u	.....	.....	.....
105	.....	.....	.....	f x u	.....	.....	.....
106	M	Inflammatory	.....	f x u	.....	Recovery	12 da.
107	(This	number omitted in	Pascal)	.....	No case	.....	.....
108	F 57	Inflammatory	.....	f x u	.....	Death	.....
109	F 15	Tuberculosis	.....	f x u	.....	.....	.....
110	35	Obstruction	.....	.....	.....	Death	.....
111	.....	Abscess	.....	f x u	.....	Death	.....
112	M 32	Abscess of prostate; tuberculosis	Rectum and bladder. (Kidneys diseased)	rf	.....	Autopsy	.....
113	F	Cancer of rectum	.....	u x f	Operation, colotomy	Death	.....
114	M 85	Ulceration of rectum	Large intestine and bladder	f x u	Operation, colotomy	Death	.....
115	M 51	Ulceration	Sigmoid, cæcum and bladder	rf	Operation, colotomy	Autopsy	.....
116	M 55	Cancer of bladder	Rectum and bladder	rf	.....	Autopsy	.....
117	M 37	.....	.....	f x u	.....	.....	.....
118	M 8	Inflammatory	Appendix and bladder F. I	u x r	Operation for stone	Autopsy	.....
119	F	Inflammatory	Bladder and intestine and skin	.....	.....	.....	.....
120	M 35	.....	.....	u x r	.....	Death	.....

121	M 44	Tuberculosis	Cæcum and bladder. F. I.	f x u	.....	Autopsy	7 mos.
122	.....	Rectal ulceration	Rectum and bladder	u x r	.....	.....	.....
123	.....	.....	Rectum and bladder	.....	Bougie	Improvement	.....
124	F	T. B. or Lues	Rectum and bladder. F. I. 2 R (Kidney diseased).	.....	.....	Autopsy	.....
125	M 40	Inflammation	Rectum and bladder	f x u	Local	Recovery	.....
126	M	Inflammatory	Colon and bladder	f x u	Suture of fistulæ by rectum	Suicide; autopsy	26 yrs. after.
127	F 41	Cancer of uterus	Rectum and bladder. F. I.	.....	.....	Autopsy	.....
128	F 69	Cancer of uterus	Rectum and bladder	.....	.....	Autopsy	.....
129	F 63	Cancer of uterus	Rectum and bladder	.....	.....	Autopsy	.....
130	F 45	Cancer of uterus	Rectum and bladder	.....	.....	Autopsy	.....
131	F 59	Cancer of uterus	Rectum and bladder	.....	.....	Autopsy	.....
132	F 52	Cancer of uterus	Rectum and bladder. (Right kidney, cancer)	.....	.....	Autopsy	.....
133	F 43	Cancer of uterus	Rectum and bladder	.....	.....	Autopsy	.....
134	M 62	Cancer of rectum	Rectum and bladder	.....	.....	Autopsy	.....
135	M 61	Cancer of bladder	Rectum and bladder	.....	.....	Autopsy	.....
136	M 60	Rectal stricture	Rectum and bladder	.....	Colotomy	Death	.....
137	M 60	Rectal ulceration	Rectum and bladder	.....	Colotomy	Death	.....
138	M 59	Ulceration	Sigmoid and bladder	.....	Colotomy	Death	.....
139	M 20	Stricture of rectum	Rectum and bladder	rf	Colotomy	Improvement	.....
140	M	.....	Colon and bladder	f x u	.....	Autopsy	.....
141	M 79	.....	.....	f x u	.....	Death	.....
142	M 65	.....	Colon and bladder. F. I. (Kidneys diseased.)	u x r	.....	Autopsy	.....
143	M 44	Inflammatory	Rectum and bladder	f x u	.....	Improvement	.....
144	M 44	Traumatic	Rectum and bladder	u x r	Operation for stone	Death	.....
145	M 54	Cancer of rectum	Rectum and bladder	rf	Colotomy	Death in 6 weeks	.....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
146	M 55	Traumatic; rectal puncture	Rectum and bladder	u x r	External urethra	Improvement	.....
147	M 60	Inflammatory (?)	Colon and bladder	f x u	.....	Autopsy	.....
148	M	Tubercular	Rectum and bladder	.....	Operation	Autopsy	.....
149	M	Traumatic	Rectum and bladder. 4 B. F. I.	u x r	Operation for stone	Autopsy	.....
150	M 30	Traumatic. Bullet wound	Rectum and bladder	.....	.....	Autopsy	.....
151	M	.....	.....	f x u	.....	Improved	.....
152	M 72	.....	Colon and bladder	.....	.....	.....	.....
153	M	Traumatic	Colon and bladder	.....	.....	.....	.....
154	M 25	.....	.....	f x u	.....	Death	.....
155	M 49	Rectum ulceration	Rectum and bladder	f x u	Colotomy	Recovery	.....
156	F 55	Inflammation	Rectum and bladder	f x u	Opening of abscess	Recovery	.....
157	F 23	Pelvic abscess	Rectum and bladder	f x u	.....	Death	4 yrs.
158	F	Ovarian abscess	Sigmoid and bladder. F. I.	f x u	.....	Autopsy	1 yr.
159	M	Gunshot wound	Rectum and bladder	.....	Division of sphincter	Recovery	.....
160	F	Child-birth	Rectum and bladder	.....	.....	.....	.....
161	M 27	Gunshot wound	Rectum and bladder	u x r	Catheter	Improvement	.....
162	M 40	Traumatic	Rectum and bladder	u x r	Medical	Recovery	.....
163	M 27	Tuberculosis (?)	Rectum and bladder	rf	Colotomy	Death in 3 weeks	.....
164	M 52	Inflammatory	Colon and bladder	f x u	.....	Autopsy	.....
165	M 58	Cancer of rectum	Rectum and bladder	rf f x u	Colotomy	Death	.....
166	M 60?	Cancer of rectum	Rectum and bladder	rf	Colotomy	Death	.....
167	F	Child-birth	Rectum and bladder	f x u	Colotomy	Recovery	.....
168	.....	.....	.....	f x u	.....	Death	.....
169	.....	.....	Colon and bladder	.....	.....	Autopsy	.....

170	76	.....	Cancer of sigmoid	f x u	.....	Autopsy	.....
171	F	Child-birth	Rectum and bladder F. I.	.....	.....	Autopsy	.....
172	M 50	Inflammatory stricture of rectum	Rectum and bladder. F. I.	f x u	.....	Autopsy	.....
173	M 60	.....	Colon and bladder	f x u	.....	Death	.....
174	M 58	Cancer of colon	Colon and bladder. (Kidneys diseased)	f x u	.....	Autopsy	.....
176	M 67	Stricture	Sigmoid and bladder. 2 B. F. I.	f x u	.....	Autopsy	.....
177	M 16	Traumatic	Rectum and bladder	u x r	Medical	Recovery	.....
178	M 46	Traumatic	Rectum and bladder	.....	Medical	Recovery	.....
179	M	Traumatic	Rectum and bladder	f x u	Catheter	Recovery	.....
180	M	Traumatic	Rectum and bladder	.....	.....	Recovery	.....
181	M 55	Traumatic	Rectum and bladder	.....	.....	Recovery	.....
182	M	Traumatic	Rectum and bladder	.....	Operation for secondary stone	Recovery	.....
183	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
184	M	Gunshot wound	Rectum and bladder	.....	.....	Recoyery	.....
185	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
186	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
187	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
188	M	Gunshot wound	Rectum and bladder	.....	Catheter	Recovery	.....
189	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
190	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
191	M	Gunshot wound	Rectum and bladder	.....	.....	Fistula persisted	.....
192	M 23	Gunshot wound	Rectum and bladder	.....	Secondary operation for stone	Recovery	.....
193	M	Gunshot wound	Rectum and bladder	.....	Catheter	Recovery	.....
194	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
195	M 26	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
196	M 35	Gunshot wound	Rectum and bladder	.....	.....	Fistula persisted. Death	13 mos.
197	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
198	M 34	Gunshot wound	Rectum and bladder	.....	Secondary operation for stone	Fistula persisted	.....
199	M 30	Gunshot wound	Rectum and bladder	.....	.....	Fistula persisted	8 yrs.

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
200	M	Gunshot wound	Rectum and bladder	.....	.....	Fistula persisted	.....
201	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
202	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
203	M 29	Gunshot wound	Rectum and bladder	.....	Secondary operation for stone	Recovery	.....
204	M	Gunshot wound	Rectum and bladder	.....	.....	Recovery	.....
205	M	Gunshot wound	Rectum and bladder	.....	.....	Death	.....
206	M	Gunshot wound	Rectum and bladder	u x r	.....	Death	27 da.
207	M 27	Gunshot wound	.....	.....	.....	Recovery	.....
208	M 22	Gunshot wound	Rectum and bladder	.....	.....	Fistula persisted	.....
209	M 39	Gunshot wound	Rectum and bladder	.....	.....	Fistula persisted	.....
210	F	Gunshot wound	Jejunum and bladder	.....	.....	Autopsy	.....
211	M 23	Traumatic	.....	rf	Secondary operation for stone	Recovery	.....
212	M 26	Tuberculosis	Large intestine and bladder. F. I. (Kidneys healthy).	f x u	.....	Autopsy	.....
213	F 52	Inflammatory	Duodenum and bladder	f x u	Cauterization of bladder orifice	Recovery	.....
214	M	Operation for stone	Rectum and bladder. (Bright's disease)	u x r	Division of sphincter twice	Death	.....
215	.....	Inflammation (?)	Rectum and bladder	.....	.....	.....	.....
216	M	Traumatic	Rectum and bladder	f x u	.....	Autopsy	.....
217	M 70	.....	.....	f x u	.....	.....	.....
218	M	Typhoid fever (?)	Colon and bladder	f x u	.....	.....	8 yrs.
219	M	T. B. (?)	Colon and bladder	f x u	.....	.....	.....
220	.....	.....	.....	f x u	.....	.....	.....
221	M	Cancer of prostate	Rectum and bladder	u x r	.....	Recovery (?)	.....
222	M 28	Operation for stone	.....	.....	.....	.....	.....

223	M 53	Cancer of rectum	.....	f x u	Colotomy	Recovery	.....
224	F	Inflammation following child-birth	Intestine and bladder. 2 B. (Kidneys normal.)	f x u	.....	Autopsy	2½ yrs.
225	F 50	Stone	Colon and bladder	f x u	Operation	Improvement	.....
226	F	Stone	.....	rf	Operation	Recovery	.....
227	M 4	Sarcoma of ileum	Ileum and bladder	f x u	.....	Autopsy	.....
228	F	Tumor of uterus	Colon and bladder	.....	.....	Death from T. B.	.....
229	F	Inflammatory	Large intestine and bladder	f x u	.....	.....	.....
230	M 27	Stricture of rectum	Large intestine and bladder	.....	Colotomy, rt.	Autopsy 10th day	16 mos.
231	F	Child-birth	Rectum and bladder	f x u	.....	Recovery	.....
232	F 25	Child-birth	.....	f x u	Colotomy	Death	.....
233	F 30	Inflammatory	Colon and bladder. F. I.	f x u	Colotomy	Autopsy	.....
234	M 50	.....	.....	f x u	.....	Improvement	.....
235	M	.....	Rectum and bladder	.....	Catheter; sphincter cut	.....	.....
236	M 69	Tuberculosis	Ileum and bladder	f x u	.....	Autopsy	.....
237	M 85	Ulceration	Rectum and bladder	f x u	.....	Autopsy	.....
238	.....	Cancer	Rectum and bladder	f x u	.....	Autopsy	6-7 mos.
239	.....	Cancer	Rectum and bladder	.....	.....	Autopsy	2 yrs.
240	.....	Cancer	Rectum and bladder	.....	.....	Autopsy	.....
241	M 79	Inflammatory	Rectum and bladder	u x r	.....	Autopsy	.....
242	.....	Cancer	Rectum and bladder	.....	.....	Autopsy	.....
243	.....	Ulceration	Rectum and bladder	.....	.....	Death. Specimen	.....
244	.....	.....	Rectum and bladder	.....	.....	.....	.....
245	M 22	Traumatic	Rectum and bladder	rf	Operation, stone removed; suture	Recovery	.....
246	.....	Operation for stone	Rectum, bladder and urethra	.....	.....	.....	.....
247	.....	Operation for stone	Rectum, bladder and urethra	.....	.....	.....	.....
248	.....	.....	Sigmoid and bladder. F. I. 2 B	.....	.....	Autopsy	.....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
249	.....	Ulceration	Rectum and bladder. 5 R	.....	.....	Autopsy	.....
250	.....	Stricture of sigmoid	Colon and bladder	f x u	.....	Autopsy	.....
251	M	Gunshot wound	Rectum and bladder	f x u	.....	.....	.....
252	M 33	Cancer of bladder	Colon and bladder	f x u	.....	Autopsy	.....
253	M 23	Traumatic	Rectum and bladder	u x r	Sphincter cut	Improvement	.....
254	M 44	Stricture of sigmoid	Rectum and bladder. (Kidneys diseased) 3 R	f x u	Sphincter cut; fistula explored	Autopsy	.....
255	M 52	Tuberculosis of prostate	Rectum and bladder. (Right kidney healthy left T. B.)	u x r	.....	Autopsy	.....
256	M	.....	Rectum and bladder	.....	.....	Not cured	.....
257	.....	Operation for stone	.....	.....	Operation	Recovery	.....
258	.....	Traumatic	.....	.....	Operation	Recovery	.....
259	M 48	Inflammation	Colon and bladder. (Kidneys diseased)	f x u	Laparotomy; suture; colotomy	Autopsy	.....
260	M	Stone	Rectum and bladder	.....	Operation	Recovery with repeated cauterization	.....
261	M 69	Cancer of prostate(?)	Rectum and bladder	f x u	.....	Death	.....
262	M 50	Cancer of rectum	.....	f x u	Colotomy	Death	.....
263	F 69	.....	.....	f x u	.....	Improvement	
264	F 50	Cancer of rectum	Ileum, colon and bladder	f x u	.....	Autopsy	.....
265	.....	Traumatic	Rectum and bladder	f x u	Sphincter cut, no catheter	Recovery	.....
266	F 25	Inflammatory (?)	.....	f x u	Medical	Improvement	.....
267	F	Perityphlitis	.....	.....	Operation		.....
268	.....	Sarcoma of bladder	.....	.....	.....	.....	.....
269	M 41	Appendicitis	Colon and bladder. F.I. (Kidneys normal.)	f x u	Operation	Autopsy	.....

270	F 23	Child-birth	Rectum, bladder and vagina	u x r	Operation	Improved	.....
271	F	Child-birth	Rectum, bladder and vagina	.....	.....	.....	.....
272	F 36	Cancer of rectum	Rectum and bladder	.....	Colotomy	Autopsy 2 years later	.....
273	F 36	Inflammatory	Sigmoid and bladder	f x u	.....	Spontaneous cure in 5 months	.....
274	M 25	Syphilis	Large intestine and bladder	f x u	Medical	Recovery	.....
275	F	Inflammatory	.....	f x u	Hydrogen gas diagnosis	.....	.....
276	M 19	.....	Rectum and bladder	.....	Colotomy	Autopsy. Death in 3 yrs	.....
277	M 28	.....	.....	rf	.....	.....	.....
278	M 50	.....	.....	f x u	.....	.....	.....
279	M 61	.....	(Kidneys diseased)	f x u	.....	.....	.....
280	M 60	.....	Colon and bladder	f x u	.....	Autopsy	.....
281	M 50	.....	.....	f x u	.....	.....	.....
282	.....	.....	Rectum and bladder	.....	Colotomy	.....	.....
283	M adult	.....	Sigmoid and bladder	f x u	Irrigation	Great improvement	.....
284	F 32	Syphilis and rectal stricture	Rectum and bladder	rf	Medical	Cured	.....
285	M	Inflammatory	Rectum and bladder	f x u	Laparotomy and colotomy	Death in 8 days	.....
286	F 34	Stone and inflammation	Colon and bladder. F. I.	.....	.....	Autopsy	.....
287	F	Peritonitis	.....	.....	Vomited urine and fæces	Death	.....
288	M	Gunshot wound	.....	u x r	Catheter and irrigation	Recovery	.....
288	M 24	Gonorrhœa and inflammation	Rectum and bladder. (Kidneys diseased)	.....	Sphincter cut and sutured; catheter	Autopsy	.....
289	.....	Cancer	Intestine and bladder	.....	.....	.....	.....
290	M 28	Appendicitis	Rectum and bladder	f x u	Laparotomy	Recovery (?)	.....
291	F	Cancer of uterus	Bladder and ileum	.....	.....	Death	.....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
292	F 28	Inflammatory (?)	.....	f x u	.....	.....	.....
293	M 5 mo.	Operation for anal atresia	.....	f x u	Operation	Recovery	.....
294	F 33	Stricture of rectum	Rectum and bladder	rf	Proposed cystotomy refused	.....	.....
295	M 35	Cancer of intestine	Sigmoid and bladder	f x u	Laparotomy	Death in 4 days	.....
296	M 50	Tuberculosis	Rectum and bladder. F.I	f x u	.....	.....	.....
297	M 36	Cancer of sigmoid	Sigmoid and bladder. (Kidneys diseased)	f x u	Laparotomy	Autopsy	.....
298	43	Inflammatory	Colon and bladder	f x u	.....	Autopsy	.....
299	17	Traumatic	.....	u x r	.....	Recovery	.....
300	7	.....	.....	f x u	.....	.....	.....
301	.....	Inflammatory	.....	f x u	Laparotomy, no suture. Simple drain	Recovery	.....
302	M 27	Traumatic and gonorrhœa	Rectum and bladder. F. I.	rf	Ext. uret (2); sphincter cut; rectum sutured (3); cath. failed; rectum pulled down and attached to end of sacrum after resection of coccyx	Recovery	.....
303	M 36	Traumatic and gonorrhœa	Rectum and bladder	u x r	Perineal dissection, sphincter cut; bladder drained	Recovery	.....
304	M 29	Inflammatory	Colon and bladder	f x u	Cystoscope and operation, suprapubic suture of orifice	Improved	.....

305	F 43	Rectal stricture	Rectum and bladder	f x u	Colotomy; laparotomy 2 yrs. later	Improved	.....
306	F 17	Inflammatory	Appendix and bladder (?)	f x u	Cystoscope; laparotomy	Recovery	.....
307	F	Typhoid fever	.....	f x u	Medical	Death	.....
308	F 62	Diverticula of Meckel	Ileum and bladder	f x u	Laparotomy	Recovery	.....
309	M	T. B.	.....	.....	.....	.....	.....
310	M 43	Cancer (?)	.....	f x u	Laparotomy twice	Death	.....
311	F 52	Cancer of sigmoid	Sigmoid and bladder	f x u	Laparotomy, resection and erroneous union	Autopsy	.....
312.	F 33	Postpuerperal inflammation	.....	f x u	cystoscoped; orifice found	.....	.....
313	F 42	Fibroma	.....	f x u	Hysterectomy; laparotomy	Great improvement	.....
314	F 60	Inflammatory	Sigmoid and bladder	f x u	cystoscoped; laparotomy	Recovery	.....
315	F 57	Inflammatory	Rectum and bladder	f x u	cystoscoped; orifice found; suture of orifice; laparotomy	Death	.....
316	M 62	Appendicitis	Appendix and bladder. F. I.	f x u	Suprapubic stone moved	Improvement	.....
317	M 25	Appendicitis	Appendix and bladder	f x u	Operations: (1) perineal section; (2) colotomy; (3) laparotomy; (4) colotomy closed	Rec. Death in 24 days from obstruction	.....
318	F 40	Inflammatory	Ileum and bladder	f x u	Cystoscoped; orifice found; laparotomy	Recovery	.....
319	M	Tuberculosis	Rectum and bladder	u x r	.....	.....	.....
320	.....	Inflammatory	Rectum and bladder	.....	Irrigation	Cured	.....
321	F 30	Actinomycosis	Rectum and bladder. (Kidneys diseased)	f x u	.....	Autopsy. Abdom. fistula; great adhesions; numerous fistula	.....
322	F 32	Actinomycosis	Rectum and bladder	f x u	Medical	Autopsy	.....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
323	M 35	Actinomycosis	Appendix and bladder. (Right ureter diseased)	.....	.....	Autopsy	.....
324	M 34	Vesical tumor	Large intestine and bladder. (Kidneys diseased)	f x u	.....	Autopsy	.....
325	F 28	Inflammatory	Sigmoid and bladder. (Kidneys diseased)	f x u	Laparotomy; (2) cystotomy; colotomy	Improvement, then death	.....
326	M 67	.....	.....	rf	Cystoscoped; orifice found	Death 2 years later	.....
327	F 42	.....	Rectum and bladder	rf	suprapubic; stone removed	No change	.....
328	M 41	Cancer of intestine	.....	f x u	Cystoscoped; nothing found	Death	.....
329	M 61	Inflammatory	Colon and bladder. 3 B. II. (Kidneys healthy)	f x u	Suprapubic	Autopsy	.....
330	F 44	Inflammatory	Cæcum and bladder	f x u	Cystoscoped; orifice found. Laparotomy. Bladder sutured; intestine not sutured	Death	.....
331	F	Inflammatory	Colon and bladder	.....	.....	.....	.....
332	.....	.....	.....	.....	Suprapubic; suture	Recovery	.....
333	.....	.....	.....	.....	Suprapubic; suture	Not cured	.....
334	M 60	Cancer of sigmoid(?)	.....	f x u	Suprapubic; bladder orifice sutured; 15 days later operation repeated, again failure	Death	.....

335	M	Syphilis (?)	Large intestine and bladder	f x u	Suprapubic; orifice not found. 2nd suprapubic failure Laparotomy. Intestine sutured; bladder not suttured	Death	.....
336	M 65	Cancer diagnosed(?)	.....	f x u	Cystoscoped; nothing found	No change	.....
337	M 40	Inflammatory	.....	f x u	.....	Death	.....
338	M 56	Inflammatory	.....	f x u	Cystoscopy; orifices found	No improvement	.....
339	M 62	Tumor of bladder	.....	f x u	Cystoscopy, suprapubic	Death	.....
340	M 13	Operation for stone	Rectum and bladder	u x r	(1) 6 ops., failures—*i.e.* perineal approach; (2) Colotomy and suprapubic; (3) Fistula op. 4 times	Cured	.....
341	F 33	Abdominal operation	Bladder and colon. F.I.	f x u	Stone removed	Autopsy	.....
342	F 40	Abdominal operation	Sigmoid, bladder and skin. 31	f x u	Laparotomy; bladder sutured, intestine resected and sutured. Drainage	Autopsy	.....
343	M 49	Inflammatory.....	.....	f x u	.....	Spontaneous recovery of fistulæ	.....
344	F 45	Inflammatory (?)	.....	f x u	Phosphatic stone found	Result unknown	.....
345	F 67	.....	.....	f x u	Sec. stone found	Result unknown	.....
346	F 42	Inflammatory	.....	f x u	.....	Spontaneous cure	.....
347	M 32	Cancer of bladder	Large intestine and bladder. (Kidneys diseased). 21	f x u	Cystoscopy; ulcer found	Autopsy	.....
347	F	.....	Sigmoid and bladder	.....	.....	Autopsy	.....

TABLE OF CASES—*Continued*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
348	M 64	Inflammatory	Colon and bladder	f x u	Colotomy	Relieved	.....
349	M 49	Inflammatory	Colon and bladder	f x u	Colotomy	Relieved. Death	2 mos.
350	.....	Inflammatory	Small intestine and bladder	.....	.....	.....	.....
351	M 50	.....	.....	f x u	.....	8 years in good health; nothing done	.....
352	M	Inflammatory	Sigmoid and bladder	f x u	Colotomy	Death	.....
353	M	Cancer of rectum		f x u			
354	M 54	Inflammatory	.....	f x u	Colotomy	Relieved. Well for 11 years so far	.....
355	M 48	Inflammatory	.....	f x u	Colotomy	Relieved for 3 years so far. T. B. of testicles 3 years later	.....
356	M	Traumatic	Rectum and bladder	rf u x v	Medical; no cath.	Recovery with sinuses	.....
357	M	Traumatic	Rectum and bladder	.....	Removal of foreign body from bladder	Recovery	.....
358	M 53	Traumatic	Rectum and bladder	.....	Medical	Spontaneous cure; later, stone removed and recovery	.....
359	M 37	Traumatic	Rectum and bladder(?)	u x	Sinuses in groin. Cath.	Recovery	.....
360	F 65	Inflammatory	Sigmoid and bladder	f x u	Laparotomy. Adhesions, mass in left iliac fossæ; considered not malignant. Colotomy	Recovered to die 6 months later from pneumonia	2 yrs. and 6 mos.
361	F	Child-birth	Rectum, vagina and bladder	f x u vag.	.....	Death by sepsis in 28 days	.....

362	M 28	Appendix abscess	Rectum, bladder and cæcum. Purulent cavity orifices. 4	f x u	Medical. (Kidneys not found diseased	Autopsy	3 yrs., 3 mos.
363	M 39	Inflammatory	Rectum and bladder	f x u	Cystoscoped orifice found. Medical, including curettage and cauterization	Improved	.....
364	F 60	Cancer	.....	f x u	None; cystoscoped; orifice found	Death	.....
365	M 45	Inflammatory	.....	rf	Cyst.; orifice found. Operation for secondary stone	.....	.....
366	F 18	Inflammatory (?)	.....	rf	Cyst.; orifice found. Gut resected	Death	
367	F	Tubal pregnancy	.....	.....	Orifice found. Laparotomy	Death	
368	M 54	Inflammation of bowel	Sigmoid and bladder	rf	Cyst.; circular ulcer found. Lap.; fæces in wound. Lap. suture and drainage	Death in 6 days	10 mo.
369	F 45	Swallowed pin 11 years previously. Passed pin by urethra	Sigmoid and bladder. 1	f x u	Laparotomy; nil	Improved	6 mos.
370	M ?	Lithotomy 21 years before	Rectum and bladder	u x r and f x u	Perineal incision. Suture of rectum. Bladder left open	Not stated	Not stated
371	M 28	Calculus (vesical). Size of hen's egg, passed by R. age of 7 years	Sigmoid and bladder. (Kidneys diseased). Surgical. 1	u x r	Abd. oper. (?). Removal of stone (?)	Died	Many years.
372	F 59	Inflammatory	Sigmoid and bladder. 1	f x u	Cystoscoped; laparotomy; Suture both openings	Cured	.....

TABLE OF CASES—*Concluded*

No.	Age and Sex	Cause	Location and number	Urine and Fæces	Treatment	Result	Duration
373	M 35	Inflammatory	Sigmoid and bladder	f x u	Bichloride irrigation	Died 1 year later	16 yrs.
374	F 64	Lifting heavy weight	Rectum and bladder. 1	f x u	Diagnosis by cystoscope; Laparotomy; rad. suture	Cured	14 mo.
375	M 44	Inflammatory	Sigmoid and bladder. 1	f x u	Laparotomy; rad.; Suture	Cured 6 months; stone 2½ x 2 inches	?
376	F	Inflammatory	Rectum and bladder. 1	f x u	Application Ag. No. 3 fistulous tract by vagina	Cured	.....
377	F 60	Inflammatory	Sigmoid and bladder. 1.	f x u	Colostomy	Improved	13 yrs.
378	M 48	Inflammatory	Sigmoid and bladder. 1	f x u	Colostomy	Improved	13 yrs.
379	.....	Inflammatory	Jejunum and bladder. 1	f x u	.....	Jewett's	.....
380	.....	Inflammatory	Rectum and bladder. 1	.....	Simple incision of skin-phlegmon	Spontaneous healing	.....
381	.....	Inflammatory; diverticulum	Sigmoid and bladder. 1	.....	Laparotomy; resection and suture	Died	.....
382	.....	Inflammatory; diverticulum	Rectum and bladder. 1	.....	Laparotomy; separation. Suture of both openings	Cure.	.....
383	.....	Inflammatory; diverticulum	.....	.....	Laparotomy; separation. Suture of both openings	Cure.	.....
384	.....	Inflammatory	Cæcum; bladder; abdominal wall	.....	Bilateral exclusion	Died.	.....
385	.....	Inflammatory strangulated herina	Small intestine and bladder	.....	Bilateral exclusion	Cured 8 years	.....

costal area. On palpation, at times, the lower pole of right kidney can be caught. Skin and glands negative. Reflexes normal; genitalia normal; considerable arteriosclerosis at radials.

Urine: First, cloudy with shreds; second, ditto. Composite examination of 30 specimens. Alkaline, albumin, trace or none, no sugar. Sp. gr. 1012–1017; pus, epith., cocci and bacilli (colon). No. T. B.; rarely blood cells; at intervals a few cylindroids and hyaline casts; *vegetable cells.* Urethra takes No. 26 French sound with ease, hyperæsthesia posteriorly. Prostate—small, soft. Vesicles, right, normal; left, thickened and tender. Mixed secretion, pus and bacilli. Definite thickening of posterior vesical structures.

Patient put on silver nitrate irrigations, urotropin preparatory to further examination.

February 15, 1908: Remarkable change; gain of 18 pounds in weight; urine almost clear; pus reduced; albumin, trace or none; rare hyaline casts; no blood; vegetable cells. Cystoscoped with Nitze cystoscope. Bladder wall healthy except at trigone. The changes are about interureteral muscle which is raised up; very granular and hyperæmic. The ureteral orifices cannot be seen. On right lateral side of the bladder there is an appearance of a crater with puffed reddened lips, projecting into bladder and about this many cyst-like bodies, described by Fenwick as "bunches of grapes." Left side, double œdematous projections with crater-like opening between the lips. In other words, there may be two orifices of fistulæ.

Proctoscopy. Just below last valve and ½ inch to right of median line two small polypoid villi can be seen. A probe introduced between these villi enters into a canal which runs into the bladder. This can be just reached by finger. Bismuth subnitrate and charcoal by mouth can be recovered in urine.

Diagnosis. Rectovesical fistula. A possible slight secondary pyelitis (right); also arteriosclerosis and possible cirrhosis of liver. Based on (1) history, (2) symptoms, (3) cystoscopy, (4) proctoscopy, (5) recovery of bismuth and charcoal in urine.

On account of general condition of patient, *i.e.*, (1) signs of cirrhosis of liver with a possible hepatic infection, arteriosclerosis (2) and lack of discomfort, local treatment was advised; *i.e.* urinary and intestinal antiseptics and bi-daily vesical irrigations. In addition, fistula to be gently curetted and touched with

silver nitrate, via rectum, with some improvement, *i.e.* no fæces for nine days, gas only three times in same period. Urine: acid, 1016, slightly cloudy. No sugar, no albumin, slight pus, bacilli (colon), rare hyaline casts.

October 20, 1908: Patient is better than he has been for years. Has had no attacks of fever since May 1, has gained to 158 pounds, and his urine is clear, free from smell, and only rarely does he pass appreciable fæces. Gas is still fairly constant.

May, 1909: Patient is in splendid health, no fæces for three months, and air only twice in the same time. Is on daily intravesical irrigations. Still under treatment.

A table of cases collected from Chavannaz, Cripps, Pascal, Sachs, from the literature and from personal communications, is printed on pages 266–284.

SUMMARY OF RESULTS.

Pascal's cases analyzed	346
To which are added	39
Total No. of cases	385
Medical	267
Spontaneous cure	5
Surgical	110
Unknown	3
Total	385

	Cured	Impr.	Unimpr.	Not known	Deaths	Total
Medical and Spontaneous	48	17	12	63	132	272
Surgical	36	16	4	7	47	110
Unknown				3		3
Total	84	33	16	73	179	385
Operative cases*	32	11	3	4	41	91
Colostomies	9	2		2	20	33
Laparotomies	13	3		1	17	34
Kidneys diseased†						25

	Cases	Orifices found	Nothing found	Not stated	Ulcer
Cystoscopies	13	8	2	2	1

* Including all operative procedures, cutting of strictures, lithotomies, sphincterotomies (primary and secondary). Deaths are considered operative when dead within three months.

† In 25 autopsies in which condition of kidneys was stated, there was ascending infection 18 times and 15 of these were bilateral.

A STUDY OF ONE HUNDRED AND THIRTY-ONE CONSECUTIVE CASES OF FIBROID TUMORS OF THE UTERUS DEMANDING OPERATION.*

BY ARCHIBALD MACLAREN, M.D.,

OF SAINT PAUL, MINNESOTA.

Professor of Clinical Surgery in the University of Minnesota.

SEVEN years ago Andrew J. McCosh presented a paper to the American Surgical Association, on the subject of Myomectomy *vs.* Hysterectomy. In reading this excellent paper again, I was surprised to find that it was so sound and up to date. Seven years ago McCosh was, if anything, ahead of his time; but the conclusions which he drew then have borne the test of time. They are as follows:

1. "Myomectomy is possible, advisable, and the operation of choice in young women, even when several tumors demand removal and even if the uterine canal has to be opened, rather than hysterectomy."

2. "In an operation of myomectomy, fear of hemorrhage should be cast aside; bold and rapid methods should be adopted."

3. "The operation is attended by the same danger as hysterectomy."

4. "The ultimate results as regards menstruation, pain, and pregnancy are satisfactory following myomectomy."

When should a fibroid tumor of the uterus be operated upon? When it commences to increase in size or to cause symptoms such as pelvic pain or hemorrhage, either at or between the menstrual periods;—and also occasionally for reflex disturbances such as persistent vomiting, which I have seen on more than one occasion.

Maurice Richardson in answering the question says: "When we postpone an operation on a fibroid tumor we may be causing the patient to run a risk beside which the dangers

*Read before the American Surgical Association, June 4, 1909.

of an operation are but trivial." Richardson thinks that the same rule should be followed as in ovarian cyst or in appendicitis in the interval; but that a small subperitoneal tumor need not be removed if it is not increasing in size. When upon examination we find a pelvic tumor, if we are careful we can usually make a correct diagnosis as to the character; but not always. And this is especially true in moderate-sized tumors which just fill the pelvis. It is not always possible to be sure that a certain tumor is uterine and not ovarian in origin; the usual error is to diagnose a small ovarian as a fibroid, on account of its smooth, hard, almost solid feel. Within the past month I have made this diagnostic mistake, even after a most careful examination. Again, we cannot be sure that a uterine tumor is innocent and not malignant in character. For this reason any tumor filling the pelvis should, in my opinion, be explored.

I have taken for the subject of this paper the last 100 consecutive hysterectomies for fibroid disease, and also the myomectomies, 31 in number, which have been performed during this same period of time.

In deciding between these two operative measures, the question of first importance is the age of the patient; a young woman should always have a myomectomy if possible. A young woman often thinks that she does not want to have a child, but a time is sure to come when she will give anything under the sun for the privilege of seeing her own child. After the child-bearing period the uterus should not be left if by so doing the woman is to run any greater operative risk, or if there is much chance of a return of her disease. I find that 70 per cent. of my hysterectomy patients were forty-five years of age or older. One patient was twenty-five years old; one, twenty-eight; and 28 per cent. were between thirty and forty-five years,—while of the myomectomies 87 per cent. were forty years of age or younger. One of the patients, over forty years of age, had been married late in life and was terribly distressed because she had recently miscarried as a result of an intramural fibroid which choked the pelvis. She gladly

accepted the slight additional risk which I then thought would probably follow a myomectomy, and one year later she was successfully delivered. Two years later she had a second child, and I am sure that she is one of the most grateful patients that any surgeon ever had.

After a myomectomy the tumor may reform, or other small growths which were too deeply buried in the uterine wall or were too small to be palpated may increase in size and cause a return of the symptoms and necessitate a second operation. This has occurred three times in my total experience of over sixty myomectomies. Perhaps there have been other cases who have not subsequently consulted me; but of the cases that I have been able to follow—and I believe that I know of the after-histories of most of my patients—the growths have not returned. Of these three cases, two later had hysterectomies, but each was glad that the attempt had been made to save her uterus. In all of these cases the return came inside of two years. After that time the chance of a return is, apparently, very small.

Myomectomy has been done during pregnancy four times with one miscarriage. In each case the symptoms present were threatened miscarriage, one being so acute as to give the attending physician the impression that this young woman was suffering from acute appendicitis with uterine hemorrhage. I would not advise the removal of a uterine tumor in a pregnant uterus which is producing no symptoms. But on the other hand I would not take the ultra-conservative position of some of the best English surgeons who have lately expressed the opinion that myomectomy before the viability of the child is almost never justifiable,—that even after labor has been established obstructing tumors may slide up and slip out of the way. I think a myomectomy just before labor is often the very best way of dealing with obstructing tumors. I remember one—a very large fibroid of the posterior lip of the cervix—completely filling the pelvis and preventing the child's head entering the pelvis at all. This tumor was enucleated from its bed without much difficulty, although there was a

profuse flow of blood which could only be stopped by packing the cavity with gauze. The attending obstetrician removed the gauze twenty-four hours later, during labor, while the advancing head compressed the cavity and the woman was successfully delivered of two perfectly healthy, vigorous children. She made a perfect recovery and has been absolutely well ever since.

In regard to the mortality: There have been five deaths in the 131 cases, or 3.8 per cent.; 3 per cent. in the series of 100 hysterectomies, and two deaths in the myomectomies, making 6 per cent. This looks like an unjustifiable mortality for myomectomy, but as both were accidental deaths, and in no way due to the myomectomy, they ought not to be charged to this operation. The first was due to the giving away of the catgut purse-string suture about the stump of an appendix which had just been removed. I have already reported this case in a paper on surgical errors read before the American Medical Association at Atlantic City, two years ago. The second death was probably due to the leaking of a gall-bladder which had been opened and drained through a stab wound, several gall-stones having been found at the time of the operation for a removal of a fibroid tumor.

For several years I have been in the habit of always exploring the upper abdomen with the gloved hand, and if the original operation was not a grave one, I did not usually hesitate to remove, after the manner described by Kelly, slumbering gall-stones when found. Some six months ago, when studying up my own statistics of gall-bladder surgery, I was amazed to find that in 20 consecutive pelvic operations where the gall-bladder had been opened and drained in this way, there had been three deaths, while the general mortality of gall-bladder surgery, leaving these 20 cases out of consideration, was only 2 per cent. Since discovering this fact, I have promised myself that I would not again follow this method, but in the future will always make a secondary opening, which can be properly packed, so that the gall-bladder can be more safely dealt with, or in the majority of cases put off the gall-bladder operation to a later and safer occasion.

Now taking up the three fatal cases following hysterectomy we find that one woman died on the third day, as the result of leaving a tape sponge in her abdomen, and this in spite of all the precautions which are thrown about the use of sponges in the abdomen. A miscount was made by one of the most excellent operating nurses that I have ever had. When we open the abdomen for the purpose of performing any operation we know that it is not without danger. All honest surgeons tell their patients that a laparotomy is not without risk; many are apt to say that there is small danger,—say about 2 per cent. The leaving of a foreign body in the abdomen is and must always be one of the sources of danger; the five and ten-yard packing rolls help very much to lessen the risk, but even then we must have some smaller sponges to mop up the blood, and occasionally one of these may escape our notice. I find that every interne, when cross-examined, knows of at least one such case, although they confess with great reluctance and never tell who the operator was.

The second death may have been a case of slow sepsis, producing peritonitis with obstruction. No autopsy could be secured, but as the patient died from obstructive symptoms on the seventh day I have always felt that it was a volvulus unrecognized until too late. A vaginal section was done on the sixth day and nothing but bloody serum evacuated. Her abdomen should have been opened and explored on this sixth day,—or better on the fifth day, as I look at it now. On general principles I am much opposed to secondary laparotomies on patients seriously ill and apparently dying. My recollections of several such attempts to save life have been that they were all unsuccessful. Usually the one chance in this class of cases is to let them alone, hoping that perhaps we are mistaken, and that they are not nearly as sick as we think.

One case died following a panhysterectomy for a sloughing fibroid of large size which was supposed to be malignant. As the tumor was raised out of the abdomen, I saw a few drops of pus drip from the cervix, which I had already closed with stitches, but which leaked just at the wrong time.

Dr. A. E. Herstler of Kansas City has recently described

his bloodless method of hysterotomy in which he uses Moynihan's stomach clamps to control the uterine blood supply and prevent hemorrhage during myomectomy. It seems to me that occasionally this procedure might be decidedly helpful; but judging from my own experience it is not usually necessary. The oozing does not come as a rule from the nutrient arteries of the tumor which Dr. Hertzler ligates, but from the whole raw surface, and from the stitch holes themselves.

One of the principal dangers of myomectomy, as well as hysterectomy, is postoperative hemorrhage. The gradual formation of an hæmatocele, which occasionally follows either operation, should be carefully watched for; because, as Deaver says, "hæmatomata in these cases are dangerous." I have been in the habit of putting in vaginal drainage at the time of the operation, when there was any difficulty in preventing oozing. And twice after myomectomy I have made vaginal section on the third day, opening up and draining such hæmatomata with the most gratifying results. After hysterectomy I have put in vaginal drainage ten times, and on five occasions have later made a vaginal section and put in a rubber tube. Symptoms of collapse, with an increase of pulse rate, will usually give the clue to the condition, and a boggy sensation in the cul-de-sac, especially if the perineum is straddled by one finger in the vagina and one in the rectum, will usually settle the diagnosis.

In my earlier work I lost two cases where the puddle of pus in the cul-de-sac was due to the infected, broken-down blood clot which though it had caused the fatal septic peritonitis was not discovered until the autopsy. To the recognition and drainage of these accumulations of blood more than to any one thing do I ascribe my improved results over a few years ago, when I used to find hæmatomata at the postmortem. If they are recognized and drained early, the patient will promptly recover. If they are not discovered the patient may recover after a long and stormy convalescence; but she probably will not. There is absolutely no shock after a vaginal section, in this particular differing absolutely from the secondary laparotomy, which is nearly always fatal.

On account of these and other experiences with vaginal section in desperately sick pelvic cases, I have made a rule for myself, that I would not let another woman die without making an exploratory vaginal section, for I have seen some truly wonderful recoveries following this procedure,—and the same can be said in regard to rectal section in men with pelvic or general peritonitis.

The danger of a fibroid tumor producing a suppurative pelvic peritonitis is considerable. In the 100 hysterectomies, three cases came to me with pelvic abscesses complicating the tumor, either due to a perforative appendicitis or to the necrosis of the tumor, or to compression of diseased appendages. Eighteen of these 131 cases had old diseased appendages. As the tumor enlarges it squeezes these old inflamed appendages against the sides of the pelvis and causes, occasionally, a slow leak, and this produces a pelvic abscess. When a fibroid tumor is complicated by a pelvic abscess the abscess should first be dealt with by vaginal section and drainage; several weeks should then intervene before attempting to remove the tumor. Many years ago I allowed myself to be over-persuaded by an anxious patient and operated too soon, removing a large fibroid ten days after a vaginal section for pelvic abscess; as a result I lost the woman with a septic peritonitis. Perhaps she would have died anyway, but by my haste I certainly did not give her the best chance to recover.

In regard to the method of performing hysterectomy: Supravaginal amputation has been the operation of choice, and only in malignant or a suspected malignancy have I resorted to complete removal of the uterus, and then for two reasons: First, because it is a less dangerous operation in my hands, and second, because I have never seen a fibroid tumor grow in the stump of the cervix after a supravaginal amputation. Large sized catgut for the vessels, No. 3 or No. 4, is the best ligature material,—or No. 2 double. It is awkward work tying the uterine arteries deep in the pelvis, and much greater force has to be used than would be necessary on the surface,—so the ligature must be larger and stronger. In my judgment, it is always wiser to cut the uterine arteries beside the cervix

before picking them up,—for they lie very close to the ureter. The only time that I have ever injured the ureter was in one of my earlier operations, when the uterine artery was ligated en masse before cutting the artery. If the danger of injuring the ureter by a poor surgeon is only one in 200, I do not believe that the uterine bougies are often necessary.

In regard to complications, I have removed the appendix in 71 cases. Inflammatory disease of the appendages has been met and dealt with 18 times. Femoral, inguinal and operative hernia have been met 5 times, goitre once—when the thyroid gland was removed before the uterus on account of the difficulty in breathing. Gall-stones were discovered and successfully removed 8 times; gall-stones were found and not removed 3 times; 7 cases were associated with procidentia, and in these cases the stumps of the round and broad ligaments were sutured to the stump of the cervix (Dudley). Drainage through the vagina was used 10 times at the time of operation. Vaginal drainage was used after the operation 7 times; all but one recovered, as mentioned above.

In regard to the influence of the fibroid tumor on pregnancy: In the 100 hysterectomy cases, 17 of these women had never married. Twenty-two who were married had either miscarried or had never had a pregnancy at all. Seventeen others who were married had not had a child for twenty years; 25 had had their last child between ten and twenty years; 4 had had a child three years and less; the remaining 11 of the 100 cases had last child between five and ten years.

Fibroid tumors were not removed until they had commenced to produce symptoms—pain from pressure on rectum or bladder—and in 32 cases on account of profuse menstruation, many of them bleeding all of the time. The hæmoglobin in one case was as low as 20 just before the operation. This woman made a recovery, but it was much slower than usual. In this latter class the best way is to keep the patient in bed in the hospital under observation and forced feeding, with big hot douches twice a day, postponing the operation until the day when they commence to flow.

RESECTION OF THE SCIATIC NERVE.

NEUROPLASTY: END RESULTS.*

BY KENNETH A. J. MACKENZIE, M.D., L.R.C.P. & S.E.,

OF PORTLAND, OREGON,

Professor of Operative Surgery in the University of Oregon; Surgeon to St. Vincent's Hospital.

ALTHOUGH a great deal of work has been done in the field of surgical neurology it is surprising how limited the general knowledge is at the present time concerning the phenomena that attend recovery of function when peripheral nerves have been destroyed or injured. The belief is almost universal that after a divided peripheral nerve has been reunited successfully recovery takes place within a very short time, whereas the process is very slow.

More than a quarter of a century ago Létiévant demonstrated that after division of the median nerve moderate pressure of a blunt object could be felt over the entire area affected. This applies to all peripheral nerves. Létiévant believed that this phenomenon was explained by the intimate anastomosis existing between nerves, the overlapping of sensory areas, and also by vibration communicated to sensitive nerves in neighboring territory. Until Sherrington demonstrated that the motor branches of mixed nerves carried with them afferent sensory fibres whose course he traced through the muscles and tendons of the arm and hand, this apparent paradox was not understood. These afferent fibres are now known to account for the residual sensibility after all the sensory nerves distributed to a part have been divided.

Wonderful additions have since been made to the knowledge of this subject by a remarkable series of studies and experiments made by Head, Rivers, and Sherren. They have not only been successful in giving finality to the problem of

* Read before the American Surgical Association, June 4, 1909.

deep sensibility, but they have placed us in possession of the knowledge that there are other sets of afferent nerves, which, associated with those mentioned, through their end-organs and fibres, receive and convey stimuli so definitely that their identification becomes easily susceptible of proof. To those who are not familiar with this literature it may be interesting to learn that the experiments which have imparted such *éclat* to the joint labors of this triumvirate were made on the person of Dr. Head himself, who submitted in April, 1903, to an operation in which both the radial and the external cutaneous nerves were divided. In proof of their painstaking methods of investigation, their work on this case extended over a term of years and was published in *Brain* in November, 1908.

Their conclusions are that the afferent fibres in the peripheral nerves can be divided into three systems: First, those which subserve deep sensibility and conduct the stimuli produced by pressure. Second, those which subserve protopathic sensibility. This system of fibres and end-organs receives and conveys painful cutaneous stimuli, and the extremes of heat and cold. These fibres regenerate rapidly after successful operation for repair of divided nerve. Third, those which subserve epicritic sensibility, The nerve-fibres and end-organs of this system endow the part with the power to respond to light touch and enable one to discriminate the two points of the compass, and also ordinary temperatures, warm and cool. Epicritic sensibility is very slow in returning.

Contrary to the accepted doctrine that sensation in its recovery spreads from the normal part over the anæsthetic area, they have proved that the reverse is the case and that protopathic sensibility, latent for a time, develops first at the outer confines of the analgesic area, spreading slowly towards its centre; in the meantime the epicritic area of sensibility remains unchanged and its outer lines can readily be defined by the cotton-wool test.

With the spread of protopathic sensibility over the analgesic area the end-organs become extremely sensitive, and at this stage of regeneration pressure causes not only the sense of

pressure, but a sensation of bruising and contusion; prick causes intense pain accompanied by tingling, which is very widely diffused, differing entirely from the effect of prick over the normal skin, at the same time localization of the pressure point is uncertain; extreme heat and cold at this time cause painful diffused sensations without the power of discrimination of heat or cold. Even when the process of regeneration and recovery has progressed thus far, the zone of epicritic sense remains absolutely unchanged.

When the diffusion of protopathic sensibility is at last complete, for a long time afterwards the affected area continues to be extremely sensitive to painful stimuli.

It is generally about this time that the epicritic sensibility begins to spread gradually over the affected area; diffusion of both in time is complete and when complete recovery is absolute. The supreme test of complete recovery of sensation is determined by the compass test; the appreciation of the two points two centimetres apart, applied simultaneously to the skin surface.

It is evident that after division of a nerve regeneration and complete recovery of function must solely depend upon conduction restored either by spontaneous healing, primary or secondary suture, or plastic device.

Protopathic sensibility appeared after successful surgical repair of the divided median nerve within an average period of fifty-six days, and was complete within an average period of two hundred and seven days.

Epicritic sensibility, under like conditions, appeared after two hundred and sixty days and was seldom completed within less than a year's time.

It is interesting to note that protopathic sensibility can be restored under conditions in which motor and epicritic recovery are impossible; and this fact is of clinical importance because of its bearing upon the cure of those serious trophic disturbances which, very often, follow the division of nerve-trunks. That complete regeneration can take place in divided peripheral nerves after three years is held doubtful, but within this period many successful cases have been reported.

In the case reported in the present communication a different set of conditions exists, which must be taken into account in gauging the measure of recovery and regeneration accruing from the operative treatment.

The lines (Fig. 5) which have been tattooed on this leg show with fair accuracy the present boundaries of the different areas. The outer line bounds the whole region and the area insensitive to light touch. The line next within marks that part of the whole affected area which is insensitive to pin-prick. Between these two lines is the zone of protopathic sensibility, which through its end-organs and fibres receives and transmits painful stimuli and extremes of heat and cold. It is not sensitive, however, to ordinary stimuli originating with ordinary temperatures, warm or cool (see Fig. 6). The darker of the two shaded areas marks the region which responds to the stimuli of deep pressure, which is, however, felt on both sides, shading where it is most readily felt to the next line without, and where it is least felt into the black area. Within this zone there is no response to prick and to temperatures of any degree, hot or cold. The innermost black region marks the area of absolute cutaneous anæsthesia and analgesia —even within this area there seems to be a remnant of response to the stimuli of deep pressure.

A study of the areas of disturbed sensibility in this case brings out the fact that the small sciatic nerve was divided at the time of the enucleation of the great sciatic. The boundaries of this area are also tattooed and show extensive protopathic recovery.

REPORT OF CASE.

GEORGE ELLSWORTH CARLISLE, single, æt. 45, height 5 feet 6 inches, weight 150 pounds. Born in Steubenville, Ohio. Complexion dark, eyes black, hair black. Occupation at intervals nailmaker, hospital steward, dining-car cook. Mother and father were both Americans. Paternal grandfather was an American. Maternal grandmother was French (French Provinces). Had four brothers: one living and well; three dead; two died past age of thirty, cause of death unknown. One died at thirty, cause

of death unknown. Had five sisters, two living and in good health. Two sisters died before he was born. One sister was burnt to death. His mother was afflicted with rheumatism. There is no history of consumption or other constitutional disease in his family. No member of his family is known to have had the skin disorder from which he suffers. At birth he was strong and in childhood he had no diseases or injuries. In adult life he had pneumonia, a mild attack, uncomplicated. He has never had syphilis.

The eruption from which he suffers developed at first in 1888, when he was twenty-five years old. Small, round, soft tumors appeared in the centre of his back, ranging in size from a millet seed to a split pea. Upon first discovery there seemed to be a large number of these growths. There were none visible at the time on the neck, face, or front of the trunk. These little tumors grew very slowly, a few of them attaining the size of a small bean. Small growths of the same kind next appeared on the forehead and temples, and in the neck, where they seemed to attain larger dimensions. Most of them were sessile, a few almost pedunculated. At this stage a few developed in the hairy scalp, but not more than three or four. The growth of these tumors has been much more rapid during the last ten years. The small growths are, generally speaking, papular in form; not a few are oval and others are circular. They are soft in texture, many of them have a yielding, velvety touch, and in a few instances the larger ones resemble in touch the soft form of lipoma. He states that on the face and chest many of these lumps would appear and grow as large as a pinhead and then slowly disappear by absorption, leaving a brown stain. A few developed on the anterior surface of the chest. The great majority of them are the size of millet seeds; between twenty and thirty of them have attained dimensions ranging in size from a pea to a good-sized almond (Figs. 1 and 2). Some of the tumors are shaped like a nipple, and others are cone-shaped. Considering their diffusion there is an apparent symmetry in their distribution, although the right hand is free, while the left is moderately involved.

In 1898 one of the tumors about the size of his fist was removed from the right arm above the inner condyle of the humerus. After its removal, the patient says the hand became

weak and the little finger and the adjacent side of the ring-finger became numb, and he could not move them, although motion returned to them two or three months afterwards, and within six months the affected hand was quite as available as the other.

At this time, while he can flex the fingers completely, he cannot extend them and there is a well-marked protopathic area, showing that the ulnar nerve was divided and not reunited. One year after the operation the muscles between the thumb and index-finger became atrophied. Practically, the growths extend down the legs to the knees, but not below, and there are none on the feet. The largest growths are, generally speaking, found on the right side of the body. There is much staining of the skin and the staining has developed, he states, since he has had this disease.

In May, 1907, patient noticed a slight swelling on the posterior mid region of the right thigh, which was painful, sensitive, and exceedingly tender to the touch. The pain accompanying the swelling passed away after two months but returned in December after it was accidently struck in climbing through a window to escape from a wrecked car. Immediately after this injury the lump in the centre of the thigh grew rapidly and became very painful. He was obliged to give up his occupation at the end of December, and by the middle of January, 1908, the pain was so severe that he could not stand or walk without great suffering. The slightest pressure over the tumor would cause the most intense local pain, which was transmitted down the leg and diffused over the foot. The pain becoming finally unbearable, he entered St. Vincent's Hospital.

Examination revealed a tumor, as large as a goose-egg, over central part of the right thigh, over the sciatic nerve, pressure on which would almost put the man into convulsions. Locomotion was difficult, and there were scattered areas on the leg of hyperæsthesia and anæsthesia; the latter, although unmeasured, were evidently in excess of the former. There was also a paretic condition of the muscles of the leg and foot on the affected side.

The diagnosis that was made at the time was: Tumor, probably of analogous nature to those on the body, growing on the sheath of the sciatic nerve, which by pressure produced the motor and sensory disturbance complained of.

The first operation was performed on February 4, 1908. A median incision was made over the tumor, extending from its upper to its lower limits. The tumor thereupon presented and proved to be the sciatic nerve with its contents, intimately adherent to the contiguous parts by inflammatory exudation, and adhesions, many recent, others well organized and dense. The incision was extended upwards to the lower border of the gluteus maximus, and below to the centre of the popliteal space. By dissection, blunt and sharp, the sciatic nerve was finally freed and segregated (Fig. 3). The whole nerve now resembled a large, fusiform tumor, every part of the nerve being involved, and extending below well to the point of bifurcation, the external and internal popliteal branches also showing conspicuous enlargement. Examination of the nerve carried with it the impression that the fusiform enlargement of the nerve was a tumor involving the whole nerve, and not, as it proved to be afterwards, a condition in which the nerve invested a large central tumor. This feature was carefully investigated at the time because of the belief that the tumor was a development of molluscum fibrosum in an unusual situation.

The surgical procedure had now to be quickly determined. (1) The rapid growth of the tumor; (2) its infiltrated condition and its tendency to infiltrate the surrounding parts; (3) its great dimensions, involving the entire area of the nerve; (4) the loss of outline of nerve structure and its evident displacement by pressure and infiltration; (5) the loss of muscular power, which was progressive; and (6) the extensive areas of anæsthesia and hyperæsthesia, not to mention (7) the great pain, and the mental and nervous strain, which by this time amounted to anguish—these considerations, and (8) the suggestion of malignant transformation of a benign growth, prompted me to the determination that excision of the nerve was the proper procedure. The upper section of the nerve was made at the lower border of the gluteus maximus between the tuberosity of the ischium and the greater trochanter, and the lower about one inch below the apex of the popliteal space.

During the resection of the nerve every effort was made to preserve any visible branches. The small sciatic nerve was not differentiated at the time of the operation. Hemorrhage was moderate and easily controlled. The anatomic parts were then

restored as carefully as possible, the wound closed in layers with iodized catgut, and the skin cut closed throughout with a subcuticular iodized suture. The patient returned to bed in very good condition. The first dressing was made on the tenth day and it was found that union had taken place throughout by first intention.

An inspection of the tumor (Figs. 3 and 4) showed the entire nerve hard, dense, and infiltrated, and palpation failed to reveal the outlines of a central growth. The tumor was fusiform in outline, flattened anteroposteriorly. On all sides, especially anteriorly, its surface showed adhesions, recent and old. The outlines of the nerve-tissue, excepting at the ends, were lost on account of infiltration and inflammatory exudation.

The segment removed was 10¾ inches in length, the diameter at its greatest part was about 3 inches. At both ends, where the tumor tapered from its central enlargement, the surface of the tumor was smooth and regular; but in the middle part the surface was extremely irregular and nodular throughout its circumference, showing that the growth had infiltrated into the whole tissue of the nerve between the bundles of nerve-fibers, and that the tumor was not a localized growth of the sheath of the nerve in which the whole nerve was stretched over the growth intact.

Upon section of the nerve by vertical incision a tumor presented itself, oval in form, its long axis lying parallel with the axis of the nerve, consisting of an exuberant mass, somewhat dense in texture, tough, hard, and fibrous, bleeding readily on the surface on examination, and bulging rather suddenly through the lips of the incision. It measured 2 inches in length and 1½ inches in its longest diameter. The tumor seemed to be encapsulated and intimately adherent to the nerve. On its anterior and posterior surface it approximated the periphery of the nerve, but on its lateral aspects it was densely covered by the nerve, although the effects of pressure could be noted upon the nerve in all directions, causing absorption and attenuation of structure, excepting the inflammatory tissues on the outside of the nerve, which were very dense, irregular, and exuberant.

The chart showing no variations of temperature, the dressings were removed on the tenth day and the wound found to be entirely healed. Examination of the leg showed that there was

FIG. 1.

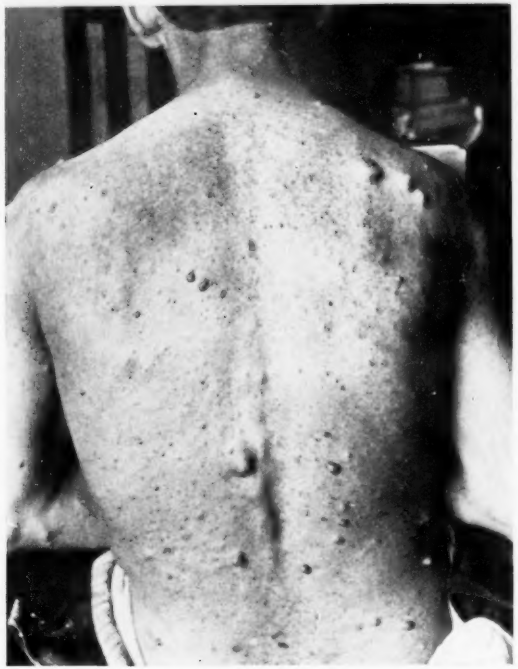
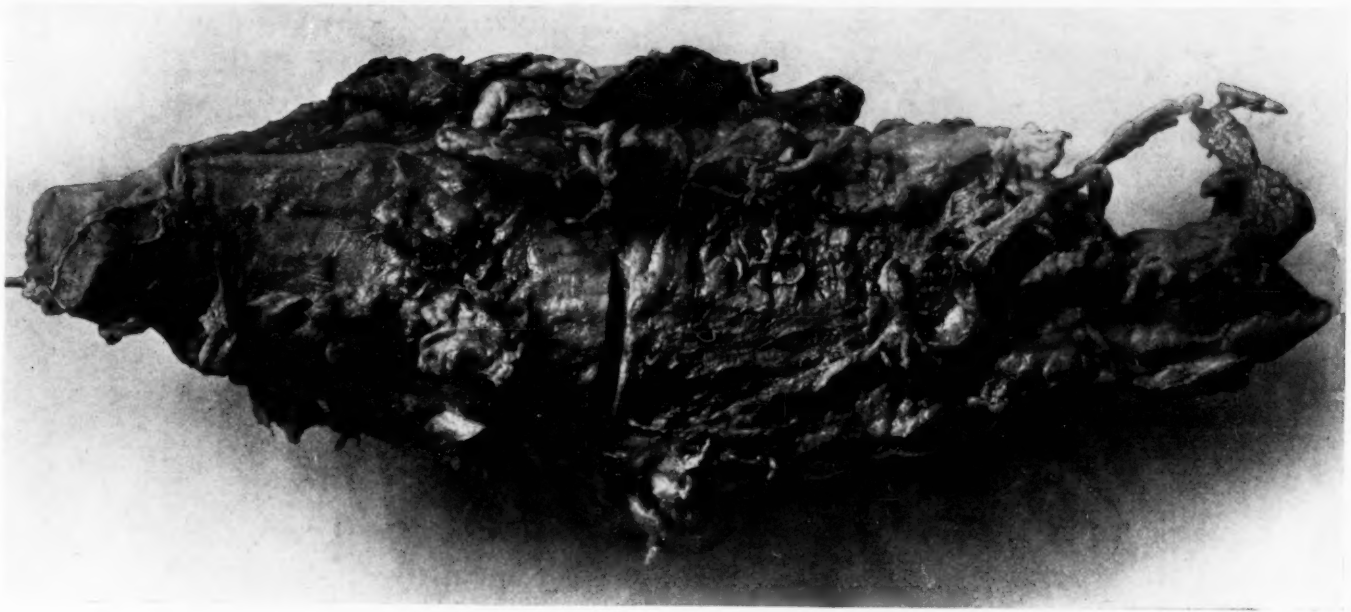


FIG. 2

Showing distribution of molluscum fibrosum.

FIG. 3.

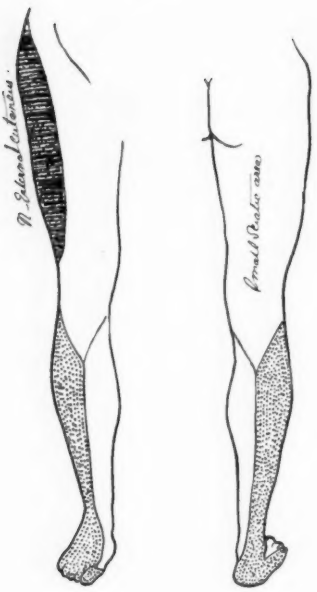


Segment of sciatic nerve removed. Posterior view. About two-thirds natural size. Note loss of nerve tissue by exudation and infiltration.

FIG. 4.

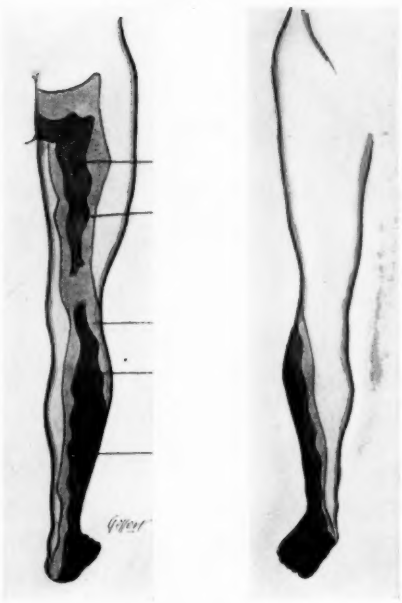
Segment of sciatic nerve. Anterior view, central tumor. About two-thirds natural size. (Drawn from specimen by Dr. S. M. Gellert).

FIG. 5.



The dotted area represents approximately the sensory area supplied by the greater sciatic nerve. The plain white area represents the sensory area supplied by the anterior crural nerve. Note the sensory area independently supplied by the small sciatic nerve and compare it with diagram (6) displaying the areas and degrees of impaired, lost and recovering sensibility in this tract.

FIG. 6.



The outer dark line bounds the whole affected area and displays the entire region insensitive to light touch (cotton wool). The next line within bounds that part of the whole area insensitive to pin-prick. Between these two lines is the zone of protopathic sensibility, which registers painful stimuli and extremes of heat and cold, but not intermediate temperatures. The darker shaded area next within is entirely insensitive to painful stimuli, but responds readily to deep pressure. The black area next within includes the zone of complete anæsthesia,—even in this area there is a remnant of response to deep pressure. Note in comparison with diagram (5) in the area of the small sciatic nerve; 1, the large area of epicritic sensibility (white); 2, the large area of protopathic sensibility (grey); 3, the small area of complete anæsthesia.

absolute paralysis of the leg, and that sensation was abolished except along the inner side of the leg corresponding to the sensory area of the anterior crural nerve. In addition to this the skin of the leg was purplish-red in color and its surface was freely covered with superimposed epithelium and a few medium-sized blebs appeared on the outer aspect of the leg and the dorsum of the foot. The leg was swollen and œdematous.

It is unfortunate that at this stage of the work no minute examinations were made to delimit the area of cutaneous anæsthesia.

Realizing that the leg in its existent condition was little better than no leg at all, it was determined at this time to bridge the gap in the sciatic by making a flap from the internal popliteal nerve in order (Fig. 14), if possible, to establish a path for the conduction of motor and sensory impulses, and at the same time to promote regeneration and to avert the catastrophe of serious trophic change. Accordingly, Carlisle again appeared before the clinic on February 20, 1908, and an incision was made from a point between the tuberosity of the ischium and the greater trochanter, following the line of the original incision in the thigh and extending to a point immediately behind the internal malleolus; the entire length of this incision was two feet six inches.

The central end of the sciatic was found retracted above the level of the lower border of the gluteus maximus. The ends of the popliteal nerves were now recovered, and as part of this operation the end of the external branch was implanted and sutured into the end of the internal branch (lateral).

The internal popliteal nerve, which was still enlarged, was then traced by careful dissection to the inner side of the ankle, and, beginning at the level of the lower border of the internal malleolus, a flap was lifted and split upwards, care being taken at every step to avoid the division of any collateral branch. The division and lifting of this flap was continued upwards to within half an inch of the divided end of the internal popliteal.

The flap was 16¾ inches in length and its diameter a shade less than one-half the diameter of the nerve. It was then laid in the bed of the sciatic nerve and, notwithstanding its length, on account of the retraction of both the divided ends of the sciatic there was little or no slack. Its end was then implanted in a split made in the stump of the sciatic nerve and held by two very

slender chromic stitches. This slender filament was about a line and a half in diameter and seemed to contain two or three fibres of the nerve. It was carefully placed over the underlying muscles and imbedded in them throughout its length by a slender iodized catgut suture.

Although the technic of the operation was somewhat elaborate the operation was not prolonged beyond one hour's time. The anatomic parts were then carefully restored in proper relation, sutured in layers, and the entire length of the cutaneous incision closed by a subcuticular iodized catgut suture, a small cigarette drain being left in the popliteal space. The leg was invested in a plaster cast and the leg and thigh adjusted at an angle of 140 degrees. The first dressing was made on the tenth day, and revealed the fact that this long incision, which exposed at least one square foot of surface, had united throughout *per primam*.

Examinations of the leg were now made from day to day, and there was no change noted, but that the leg could be very feebly flexed and it was evident that improvement had taken place in the texture of the skin, which seemed to possess better color, and hereafter the tendency to the formation of blebs and ulcers seemed gradually to pass away.

Believing now that if the transplantation of a few fibres split from the popliteal nerve bridging this large gap in the sciatic nerve would do good by establishing conductivity and promoting regeneration, the addition of a few more fibres might augment the benefits, a third operation was done on April 7, 1908, 67 days after the first operation and 46 days after the second operation. The patient in the interval had been allowed to sit up and move about in a wheel chair, and the limb was handled daily by massage, etc. The third operation consisted in an attempt to split the external division of the sciatic nerve in order to utilize it in the same manner. Incision was made throughout the entire length of the leg as in the previous operations. A careful inspection and dissection of the field of the first operation enabled one to note a definite path of nerve-tissue established in the sciatic gap. The dissection of the external popliteal was much more difficult, but it was finally traced to the same length as the internal and a flap lifted up and placed in the sciatic gap, and tucked in a separate muscular bed to the outer side of the other branch, its ends implanted into a niche previously cut in the stump of

FIG. 14.

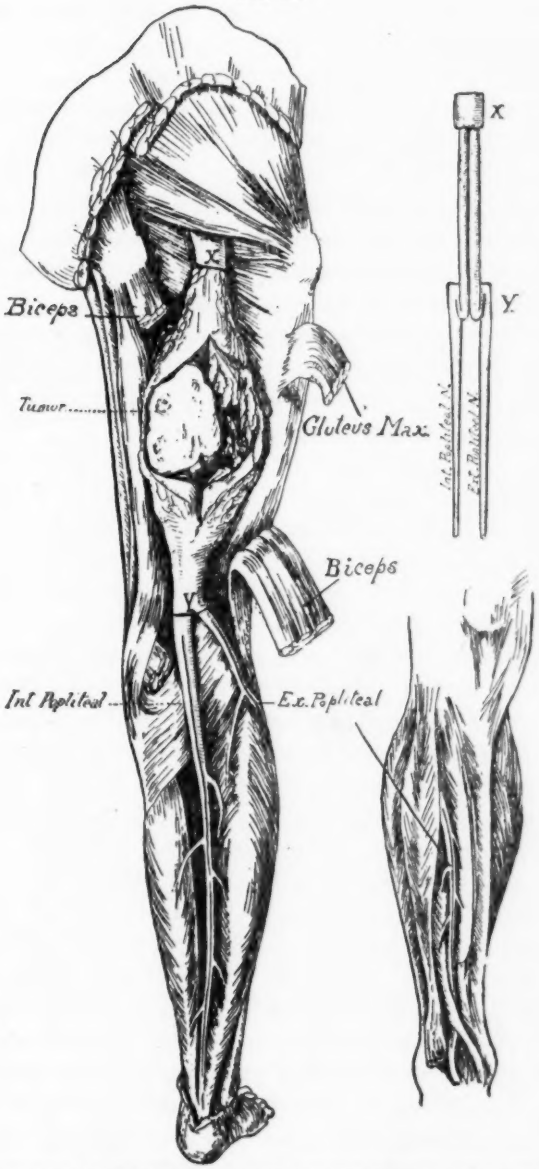


Diagram to show the position of the tumor, the part resected, and the method of division of the internal and external popliteal nerve; also the scheme of suture. (Sketch by Miss S. Hayes).

the sciatic nerve. It was noted in this dissection that only a very moderate amount of scar tissue had formed in the line of the first transplantation. The wound was closed and dressed in the same manner as in the previous operations.

After two weeks the cast was removed for dressing and inspection, and the wound was found to have healed for the third time throughout by first intention. Two weeks later the cast was removed and an adjustable splint applied, which permitted the leg gradually to be extended to a straight line. Hereafter treatment by massage and electrotherapy was instituted and has been continued, more or less, throughout. Examinations showed no change in the areas of sensory disturbance, but it was manifest now that the leg could be bent upon the thigh with more freedom and energy, although it was noticed that there was very little muscular power in the movement.

The external appearance of the leg was at this time flabby and shrunken, the skin harsh and of a purplish color, with a tendency in areas to the collection of epithelial scales in layers. The affected muscles of the leg and thigh became flabby and flaccid, and wasted and failed to respond to the faradic current, and were the seat of the reaction of degeneration. Trophic conditions, however, by this time had improved, and there was now no tendency to the formation of blisters, blebs, and ulcers, although slight traumatisms had led to the loss of one or two nails of the foot. When he was permitted to walk after the removal of the plaster cast, there was no pain or discomfort, other than what was described as a numb, heavy sensation in the leg and foot. Attempts at locomotion showed at this stage an ability to flex the leg upon the thigh moderately, but the condition of foot-drop was absolute. Whenever the leg was flexed it was promptly extended, but the foot dragged in the most helpless way, the position of the foot with reference to the leg being that of a flail. The attitude of the foot is mentioned as showing the loss of every vestige of muscle control.

Electrical observations taken about two months after the last operation showed reaction of degeneration [R. D.] in the hamstrings supplied by the sciatic and also the flexors of the leg and the flexors and extensors of the foot. Observations made four months later, that is, six months after the last operation, showed only partial R. D. of the hamstring muscles and the flexors of

the leg, but complete R. D. of the flexors and extensors of the foot. Observations taken in April showed normal electrical recovery of the hamstrings and the flexors of the leg, partial R. D. of the extensors of the foot, and complete R. D. of the flexors of the foot.

ANALYSIS OF THE EFFECT OF THE INJURY.

The excision of the sciatic nerve *in toto* predicates the elimination of all motor and sensory transmission throughout the area supplied by the sciatic nerve and its derivatives. It has not been shown that by anastomosis or the overlapping of territory the anterior crural nerve can contribute much towards the rehabilitation of a district that has been blighted by the removal of the sciatic. Clinical evidence protests the contrary; the sciatic nerve was divided at the level of the gluteus maximus, the first fibres delivered to the hip-joint were probably untouched; the muscular branches distributed to the flexors of the leg, namely, the biceps, semimembranosus, semitendinosus, and the branch to the adductor magnus, were divided. These muscles afterwards wasted and showed a state of flaccid atrophy and paralysis. It is not necessary to say that the entire area of sciatic sensory distribution, that indicated by the diagram, was entirely cut off.

It is more interesting in this study, which involves so intimately the problem of regeneration, to take into account the motor disturbance; and attention is called to the fact that in addition to the hamstring group of muscles already mentioned the muscles supplied by branches of the internal popliteal nerve, namely, the gastrocnemius, plantaris, soleus, and popliteus, were deprived entirely of their nerve-supply, and this group wasted very rapidly and promptly showed the reaction of degeneration; that the flexors of the foot, the tibialis anticus, the extensor longus digitorum, the extensor longus hallucis, and the peroneus tertius were shorn of their nerve-supply and underwent the same paralytic changes; that through the external popliteal branch the extensors of the foot, namely, the tibialis posticus, the flexor longus digitorum, and the flexor longus hallucis, were similarly involved, and likewise the peroneal group and all the groups of smaller muscles of the foot.

I have individualized these muscles and groups of muscles in order to afford a better grasp of the extent to which regeneration has taken place as indicated by motor recovery. It was for a long time held doubtful that regeneration could take place in a nerve in which continuity was lost by division or excision of a segment. It is now known that regeneration will take place over short gaps without previous repair. Hueter has pointed out that it is impossible for regeneration to take place in a nerve over a gap of 1¾ inches or more. Victor Horsley, confirming in general the observations of Heuter, places the limit, from the standpoint of his experience, at 1¼ inches.

It is submitted in this case that a gap of 10¾ inches was made in the sciatic nerve; that, immediately after the removal of the nerve, not only was all sensory and motor transmission eliminated throughout the sciatic area, but in addition all means of conveyance of stimuli by afferent nerves of whatsoever kind; that extensive regeneration has taken place by virtue of an operation in which a gap of 10¾ inches in the sciatic nerve was bridged by two delicate flaps 16¾ inches in length lifted from the two main branches of the sciatic nerve; and that the process of regeneration is progressive are now beyond doubt, and in proof that regeneration has taken place the evidence is listed as follows:

1. Trophic recovery is practically complete. There is now no tendency to the formation of blebs and ulcers and the skin has recovered its natural texture and color.

2. There has been extensive development of protopathic sensibility, much more than could possibly be explained by overlapping from the district of the anterior crural nerve.

3. There has been much recovery of epicritic sensibility, as shown by comparison of the areas of sensory distribution in both legs by diagram.

4. There is almost universal recovery of deep sensation, which is said to be lost when all motor and all sensory nerves to a given part are divided.

5. Recovery has taken place of motion and power in large groups of muscles, which immediately after the excision of

the nerve were reduced to a paralytic state, displaying the usual signs of paralysis and the reaction of degeneration, viz.: (*a*) The flexor group in the thigh: the complete recovery of the semimembranosus, the semitendinosus, and the biceps. (*b*) The flexor group of the leg, the gastrocnemius, the plantaris, the soleus, and popliteus: extensive recovery has taken place in this group and it is progressive. (*c*) The flexors and extensors of the phalanges and foot. Minute examination of these muscles show them now to be firm, strong, and capable of contracting; and while they do not move the foot, they control it, and there is no tendency to foot-drop; some of the muscles of these groups now show only partial reaction of degeneration.

6. The sign afforded by the foot. In the earlier stages of locomotion the foot was helpless and dragged; at the present time it shows muscular control and easy locomotion.

7. The relatively small and contracted area of absolute cutaneous analgesia.

8. The relatively small area of thermic anæsthesia, which is practically coterminous with the area of absolute analgesia.

9. The direct sensibility of the new nerve-tract to deep pressure and the transmission of painful sensibility thereby to the foot.

10. The possession of muscular sense unimpaired.

11. Independent and unaided locomotion.

The following factors may be mentioned which have contributed to the successful results in this case:

(1) Early operation, which the writer believes to be imperative. It might have been better if the neuroplastic work had been done immediately after the removal of the tumor. (2) Implantation in the gap of a large "nerve-element" to establish a nerve-path and foundation for regeneration. (3) The infolding of the nerve-flap in muscular bed so as to prevent the destruction of the delicate nerve fibrils by early formation of scar tissue. (4) The impetus to regeneration of large and dense termini, especially at the central end. (5) The absolute asepsis in three successive operations.

Conclusion.—The lessons to be learned from this case,

while not manifold, are important. It tends to show that regeneration takes place from the peripheral as well as from the central end of a divided nerve.

It demonstrates that in given cases peripheral flaps will suffice when central flaps are not available.

Its most obvious lesson, however, rests in the fact which it discloses that by means of plastic operations regeneration on a large scale and recovery of sensation and motion on a corresponding scale can take place after injuries to and operations upon peripheral nerves from which segments have been removed of varying lengths, the limit established by this case being 10¾ inches.

Grateful acknowledgment is made of the valuable services rendered in the various operations and in the preparation of this study by Dr. Frank M. Taylor, Dr. S. M. Gellert, Dr. E. B. Waffle, and the senior members of the class in operative surgery of 1908. Special acknowledgment is made of valuable suggestions made by Dr. R. E. Dolby, of Vancouver, B. C.

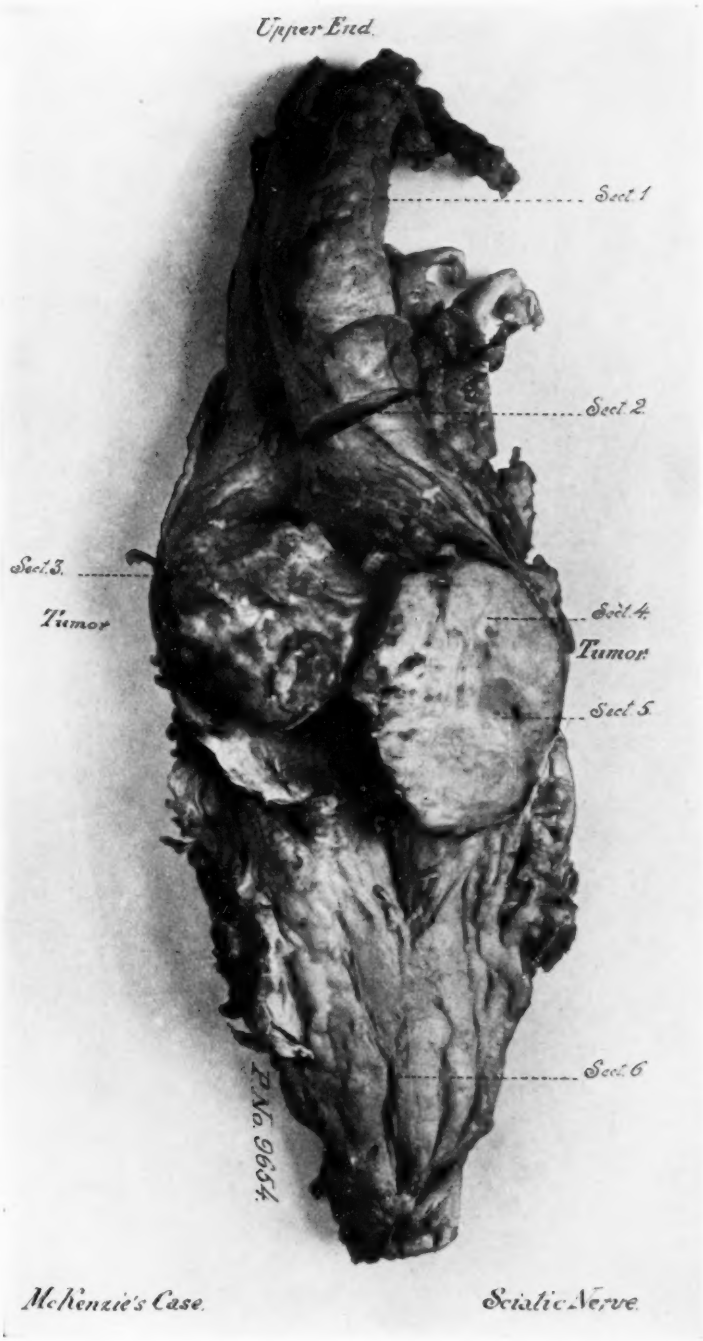
NOTES ON MOLLUSCUM FIBROSUM.

According to Von Recklinghausen this condition develops from the cutaneous nerves and belongs to the neurofibromata. According to Ribbert the cause rests in some disturbance of normal development, as a result of which there is an irregular distribution and arrangement of the connective-tissue elements of the nerves, permitting independent growths. Von Bruns includes molluscum fibrosum, plexiform neuroma, lobulated elephantiasis, pigmented moles, the soft warts, and fibroma of the large nerves under the title of elephantiasis nervorum.

Neurofibromata are relatively common; they grow from the ends of nerves, also from the connective-tissue and perineurium, and are often traversed by nerve-fibres which have been detached by the growths. Tumors of the large nerves grow as a rule very slowly and develop in middle age.

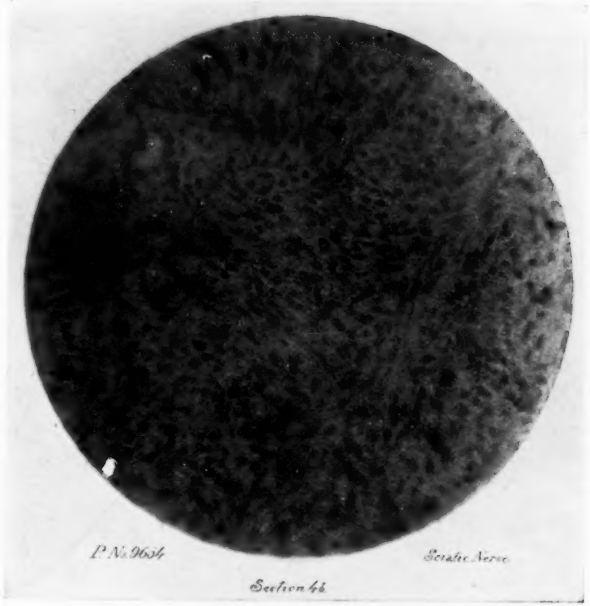
Von Büngner states that sometimes they attack all the nerves, and that in 12 per cent. of general neurofibromatosis fibro- or myxo-sarcoma develops from one or other of the nodules. Garré describes these conditions as secondary

FIG. 7.



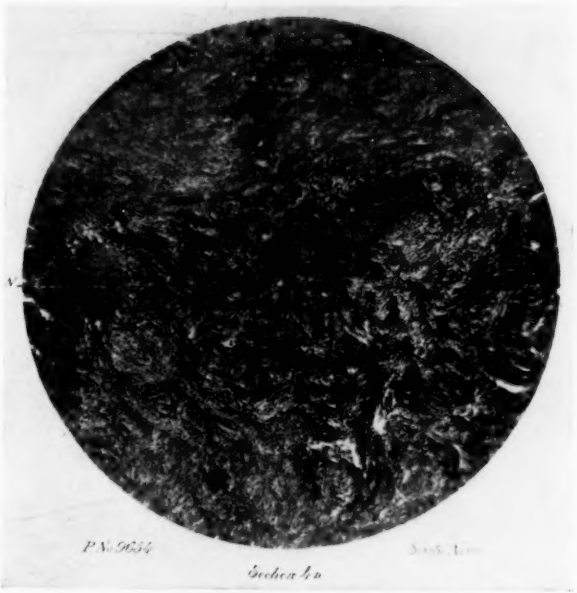
Photograph of specimen removed showing the positions from which the sections were removed for microscopic study. Section 1, upper end of nerve; Section 6, lower end of nerve; Section 3, portion of nerve behind tumor; Section 4, *a* and *b*, tumor; Section 5, similar to Section 4. (See photomicrographs by Mr. H. Schapiro.)

FIG. 8.



The tumor proper—cellular portion; chiefly spindle cells in a fibrous and myxomatous stroma. (The photomicrographs were made by Mr. Herman Schapiro.)

FIG. 9.



Portion of tumor stained with Mallory and Wright connective-tissue stain. In this area the tumor was much less cellular than in Section 4, *b*. *N*, apparently the remains of a nerve fibre.

FIG. 10.

Nerve, upper end. *Mx*, myxomatous residues seen in epineural tissue. The three nerve trunks (*N*) show very little degeneration.

FIG. 11.

Lower end of nerve. The nerve trunk is larger than in Section 1; there is an increase in endoneural tissue; there is some degeneration of axis cylinders and sheaths. The rudiment shown in Section 1 is also seen here.

FIG. 12

High-power photomicrograph of area marked *Mx* in Section 6, showing myxomatous tissue of the congenital rudiment surrounding a small nerve trunk, *N*.

FIG. 13.

Degeneration of nerve fibre with definite infiltration of tumor cells. Compare this nerve fibre with those shown in Sections 1 and 6

malignant neuroma in contradistinction to primary sarcoma or glioma developing in nerves.

PATHOLOGICAL REPORT.

BY DR. J. C. BLOODGOOD.

The tumor of the sciatic nerve sent by Dr. Mackenzie for examination has been recorded in the surgical pathological laboratory of the Johns Hopkins Medical School and Hospital under the number 9654.

The tumor is malignant—a sarcoma. The sarcoma belongs to that variety which arises from the fixed connective-tissue cells, and in this case it undoubtedly originated in the perineural connective tissue. It is chiefly a spindle-cell sarcoma, but there are areas in which there is a great deal of fibrous tissue. Photomicrograph, Sect. 4b (Fig. 8), pictures the cellular portion of the tumor, and photomicrograph, Sect. 4a (Fig. 9), stained with Mallory and Wright connective-tissue stain, illustrates a portion of the tumor in which fibrous tissue is in excess.

I am not prepared as yet to give a full report on degeneration of the nerve-fibres. In photograph, Sect. 1 (Fig. 10), the nerve above the tumor, as compared with photomicrograph, Sect. 6 (Fig. 11), the nerve below the tumor, one can see that some nerves pass through without degeneration. For this reason I would expect that the patient did not have complete loss of nerve-function; that some of the nerve-bundles were completely degenerated is shown in photomicrograph Sect. 3 (Fig. 13). This was taken from below the gross tumor and shows a nerve-bundle in which it is impossible to make out, except here and there, an axis cylinder and sheath. The perineurial connective tissue still confines the nerve fibre, but the endoneurial connective tissue is practically replaced by tumor cells and degenerated tissue.

The gross appearance of the tumor is shown in the photograph by Mr. Schapiro (Fig. 7). The tumor proper is situated in the sheath of the sciatic nerve; it has pushed the nerve aside and excavated for itself a bed. The tumor is therefore of perineural origin. In the tumor proper I can make out no gross or microscopic evidence of nerve-fibres. This tumor (Sects. 4 and 5) is a fibro-spindle-cell fibrosarcoma, illustrated in photomicrographs, Sects. 4a and 4b. The growth, however, not only produces pressure upon the nerve, but there is direct infiltration into the nerve itself by tumor cells. However, both in the gross and microscopic section, it seems to me that I can trace nerve-bundles through. They apparently lie anterior, if I am correct in assuming that the tumor was posterior. When a section is made through at about the level of Sect. 4 (Fig. 2) the tumor can be seen with a semilunar-shaped nerve-trunk to the anterior side. That some of the nerve-bundles are degenerated is shown from photomicrograph, Sect. 3, taken from the nerve-trunk proper just anterior to the tumor.

Both in Sect. 1 and in Sect. 6, illustrated in the photomicrographs of this number, and in Sect. 2, not illustrated, we see a cellular myxomatous tissue (*Mx*) which probably represents the so-called "Anlage" or rudi-

ment of the tumor. In photomicrograph 6b (Fig. 12) we have a high power of one of these areas.

The lower end of the nerve, Sect. 6, is considerably larger than the upper end (Sect. 1). This is due apparently to hypertrophy of the epineural connective tissue shown in Sect. 6, and an enlargement of the nerve-fibre within the perineurium, and this enlargement seems to be due to increase in the endoneurial connective tissue.

For this tumor resection was undoubtedly the only procedure that promised any hope of a permanent cure. The tumor also belongs to that large group of simple sarcomata in which cures are generally accomplished. The histology of this tumor corresponds with two observations of my own which have remained well, one six years and one three years after operation, but in another case in which the position and histology of the tumor somewhat resembled the position and histology of the tumor in your case, the patient had a free interval, first of seven months after resection, and then a second free interval of four years after amputation for recurrence.

The histological evidence of the "Anlage" (see 6b) of the tumor in the sections taken from the upper and lower end of the nerve, I fear, must be looked upon as evidence suggesting a possible recurrence, but I do not think we know as yet enough about tumors of nerves to be absolutely certain as to this point.

REFERENCES.

Ballance and Stewart: "The Healing of Nerves," London, 1901.

Bowlby: "Injuries of Nerves," Lancet, July 26, 1902.

Head, Rivers, and Sherren: "The Afferent Nervous System from a New Aspect," Brain, Part ii, November, 1905.

Horsley, Victor: "On Injuries to Peripheral Nerves," Practitioner, August, 1899.

Killvington, Basil: "Investigation of the Regeneration of Nerves," British Medical Journal, April 29, 1905.

Létiévant: "Traité des Sections Nerveuses," Paris, 1873.

Lexer-Bevan: "Neurofibromatosis," System of Surgery.

Murphy, John B.: "Neurological Surgery," Surgery, Gynæcology, and Obstetrics, vol. iv, No. 4, April, 1907.

Powers, C. A.: "Bridging of Nerve Defects," Annals of Surgery, November, 1904.

Rivers and Head: "A Human Experiment in Nerve Division," Brain, Part iii, November, 1908.

Sherren, James: "Secondary Suture of the Great Sciatic Nerve," British Medical Journal, Feb. 16, 1907.

Sherrington: "On the Anatomical Constitution of Nerves of Skeletal Muscles," Journal of Physiology, 1894-'95, vol. xvii, p. 211.

Spitzy, Hans: "Technique of Neuroplasty," American Journal of Orthopedic Surgery, August, 1904.

Taylor, R. Tunstall: "Operative Treatment of Infantile Paralysis, with Special Reference to Neuroplasty," New York Medical Journal, July 7, 1906.

OBSERVATIONS ON THE INEQUALITIES OF THE RIGHT AND LEFT FEMORA.*

BY ALGERNON T. BRISTOW, M.D.,

OF BROOKLYN, NEW YORK,

Surgeon to the Long Island College, Kings County and St. John's Hospitals.

THE opening sentences of the second chapter of Darwin's "Descent of Man" are as follows:

"It is manifest that man is now subject to much variability. No two individuals of the same race are quite alike. We may compare millions of faces and each will be distinct. There is an equally great amount of diversity in the proportions and dimensions of the various parts of the body, the length of the legs being one of the most variable points."

The late Dr. Jarvis S. Wight, in two valuable papers written in 1877 and 1878, called attention to the inequalities of the lower limbs, which occur normally,—that is to say, in case where no fracture has ever occurred,—and he pointed out the importance of recognizing this fact in the treatment of fractures, not only from a practical but also from a medicolegal standpoint. The first paper of Dr. Wight was published in the *Archives of Clinical Surgery,* vol. i, No. 8, February, 1877, and the second paper appeared in the "Proceedings of the Medical Society of the County of Kings," January 21, 1878.

In the first paper, which was in effect a report of a clinical lecture, Dr. Wight, after rehearsing the fact that experts differ in their measurements of limbs, and that one expert will sometimes have various differences after several comparative measures of the two limbs, states that it occurred to him to make a number of measurements of the lower limbs of those who have never had the femur broken. These measurements were all made from the anterior superior spine of the ilium to the lower

* Read before the American Surgical Association, June 5, 1909.

extremity of the internal malleolus, with the figures of the tape line down, so as to be invisible. Dr. Wight thus measured 60 individuals; in only ten out of the 60 cases were the lengths of the two lower extremities equal. We may tabulate his results as follows:

Cases	Variation of limbs
10	no
4	⅛ inch
25	¼ inch
13	½ inch
4	⅜ inch
1	⅝ inch
1	⅞ inch
1	1 inch
1	1⅜ inch

In considering the importance of these differences we may certainly exclude the four cases in which the difference was but ⅛ of an inch and the 25 cases in which the difference was but ¼ of an inch as of no practical importance. Not so, however, with the remaining 21 cases, being more than 34 per cent. of the whole number measured. In these 21 cases in which the variation exceeded ¼ inch, there were 4 of ⅜ inch; 13 of ½ inch, and one each respectively of ⅝ and ⅞ inch, one inch and one inch and three-eighths variation, and this in individuals who had never been the subject of fracture.

Dr. Wight very justly observes, in view of these figures, that to assume in cases of fractured femur that the two femora were usually of the same length, might involve an error of more or less gravity. In fact in the series in question, taken at random, 10 only out of 60 cases had lower extremities of equal length. Dr. Wight also quotes an article by Dr. W. C. Cox, *Am. Jour. Med. Sciences,* April, 1875, where the reporter states that after accurately measuring the normal lower limbs of 54 individuals there were 15 cases which showed a difference of ½ inch or more, the greatest difference being ⅞ inch.

In November of 1877 Dr. F. H. Hamilton (*Hospital Gazette and Archives of Clinical Surgery*) ridiculed the claims of

Dr. Wight concerning the frequency of inequality in the lower limbs, and January 21, 1890, at a meeting of the Medical Society of the County of Kings, Dr. Wight replied to him by citing the results of 42 measurements in a new series of cases. In this series there were 13 cases in which the normal lower limbs were of equal length and 29 cases in which inequalities existed. Tabulated as follows:

Difference	Number of cases
⅛	1
¼	14
⅜	5
½	4
⅝	3

Combining the two tables of Dr. Wight the left lower limb was the longest in 52 cases, the right in 27 cases. In 26 cases there was a difference of half an inch or more and in 9 cases the difference was over half an inch. The brief controversy between Dr. Wight and Dr. Hamilton was ended by a letter from the latter to the former, in which he states that after a dozen measurements made with great care by himself and his house surgeon, a large majority were of unequal length, the left being generally the longest, and he acknowledged the correctness of Dr. Wight's position.

It is somewhat strange that this matter of the inequality of the lower limbs with its bearing on the question of fractures of the femur has received so little attention in the textbooks. In " Gray's Anatomy " a brief footnote simply refers to the claims of Dr. Wight. The matter seemed of sufficient importance to the writer, however, to merit further investigation, and as Dr. Wight's papers had no dissecting-room data, it seemed wise to have actual measurements of disarticulated bones in order to determine beyond the possibility of a doubt whether Dr. Wight's claims could be substantiated. The actual bone measurements were chosen because it is evident that whatever divergence might exist between different observers when measuring from the anterior superior spine to the lowest point of internal malleolus, no such divergence was

possible in laboratory measurements of companion bones. The humeri were also examined and compared in order to determine the truth of Dr. Wight's claims that when the femora were unequal the humeri were also unequal, the inequality being hemilateral. It is evident, of course, that in cases of fracture of the femur, if this be a fact, that the measurement of the humeri in the same individual would indicate whether the femora were originally equal, and if not, which side was originally the longest.

The writer desires to submit tables of measurements of 124 cases, in all of which measurements of paired humeri and paired femora were made. One series of cases of 54 were measured in the anatomical laboratory at Columbia University. Another series of cases, 50 in number, were measured in the anatomical laboratory at the University and Bellevue Medical School, and a small series of 20 cases from other sources were made by my assistants, Drs. E. H. Fiske and R. M. Rome. I wish to acknowledge the great courtesy offered me at the anatomical laboratory at Columbia University and also the University and Bellevue Medical School. I am indebted to Dr. Fred. Tilney, associate in anatomy, for the measurements made at Columbia, and to Dr. W. C. Cramp for the measurements made in the University and Bellevue Medical School. The work was laborious and time consuming, and I deeply appreciate the invaluable assistance of the gentlemen who so kindly rendered it possible for me to write this paper.

I submit first the tabulation of measurements made by the Department of Anatomy, Columbia University. The measurements are in centimetres. The entire bone was measured at Columbia with an apparatus similar to the familiar shoemaker's rule with sliding arm. At Bellevue the measurements were taken from the tip of the great trochanter of the femur to the external condyle. The Columbia measurements were made on 54 subjects. The University and Bellevue on 50 cases.

The Long Island cases were 24 in number, making a total of 128 subjects, a total of 512 measurements.

TABLE I.—Columbia University, Department of Anatomy.

No. of Subject	Humerus		Femur		No. of Subject	Humerus		Femur	
	R	*L*	*R*	*L*		*R*	*L*	*R*	*L*
1805	31.6	31.4	43.	43	2096	34.1	33.8	45.4	46.1
1812	31.2	31.6	42	42.4	2001	34.4	33.8	45.4	45.1
1778	33.4	34.	48	47.8	2042	31.2	31.4	43.6	43.6
1752	34.8	34.6	47.8	47.4	2023	33.2	33.4	47.8	47.6
1762	31.8	31.4	43	42.4	2061	34.4	34.2	46.1	45.8
1768	32.2	32.2	45.8	46	2005	34.1	33.6	44.8	45
1790	33	32.2	45.8	46	2085	32	32	45.1	44.8
1798	33.8	33.4	48.6	48.4	2013	35.	35.1	47.4	48.1
1774	32.6	32.2	44.8	44.4	2044	33	32.4	44.2	44.6
1757	32.8	32.1	46.4	46.	2088	32.8	32.9	43.	43.
1785	34.	34.	46.8	47.4	2098	35.	34.8	51.8	51.6
1766	31.4	31.4	45.4	45.4	7A	32.4	32.4	45.4	46.4
1755	34.1	34.	48.	47.1	2008	29.6	29.1	42.	41.8
1694	32.	32.4	46	46.	1759	33.	32.8	44.	43.8
1816	32.4	32.	45.	45.2	2089	31.8	30.8	44.	44.
1782	31.2	31.1	44.2	44.2	2068	34.1	33.8	47.1	47.2
1784	32.4	32.8	45.4	45.6	2079	34.6	33.	43.2	43.2
1815	34.	34.1	48.8	49.1	18A	34.	33.1	47.6	47.2
1799	31.8	31.8	43.6	44.	2060	32.8	32.	46.6	45.9
1743	32.2	32.2	43.2	43.	2070	31.1	31.4	42.6	42.8
1760	31.8	32.6	42.2	43.	2075	33.8	33.	48.6	48.
1818	31.2	31.	43.4	43.4	2086	27.4	27.2	38.	38.
1767	31.4	31.2	43.	43.	124	34.5	34.8	46.	46.
57	32.2	32.	43.	43.	102	33.4	32.9	47.	46.5
55	32.	32.4	44.4	45.2	54	31.4	31.2	43.	43.4
50	32.9	32.2	45.	44.	118	30.8	31.	43.	43.2
64	33.4	32.2	46.1	46.6	105	32.4	31.5	43.8	44.4

Review and analysis of Table I bring out the following facts:

First, that the length of the human femur and humerus varies in such a way as to make possible a division into four classes upon this basis, as follows:

Class I.—Femurs equal, humeri equal in same subject. Frequency, 1.8 per cent. Reference, Case No. 1766.

Class II.—Femurs equal, humeri unequal. Frequency, 22.2 per cent. References, Cases No. 1805, 1694, 1782, 1818, 1765, 57, 2042, 2088, 2069, 2079, 2086, 124.

Class III.—Femurs unequal, humeri equal. Frequency, 11.1 per cent. References, Cases No. 1768, 1785, 1799, 1743, 2085, 7a.

Class IV.—Femurs unequal, humeri unequal. In this class two types to be distinguished, *i.e.*, Type A: Greater length of homolateral humerus and femur; Type B: Greater length of contralateral humerus and femur. Frequency, 64.8 per cent. References: Type A, Cases Nos. 1812, 1752, 1762, 1790, 1798, 1774, 1757, 1755, 1816, 1784, 1815, 1760, 55, 50, 64, 2001, 2061, 2005, 2013, 2098, 2008, 1759, 18a, 2060, 2070, 2075, 102, 118. Type B, Cases Nos. 1778, 2090, 2023, 2044, 2068, 54, 105.

Second, that in the subjects presenting inequality of the humeri, the greater length was observed on the right side in 34 cases as against 11 on the left side, while the cases which showed inequality in the femurs were 19 on the right side having the greater length as against 18 on the left side.

Third, that in cases in which the right humerus was longer than the left, the maximum difference between the two sides was 12 mm., whereas in those cases in which the left humerus was longer than the right the maximum difference observed was 4 mm.

TABLE II.—University and Bellevue Medical School, Department of Anatomy.

No. of Subject	Humerus		Femur		No. of Subject	Humerus		Femur	
	R	*L*	*R*	*L*		*R*	*L*	*R*	*L*
1	31.	31.	38.5	39.	26	36.75	36.5	52.5	53.
2	31.5	31.5	39.	39.25	27	33	33	44	44.25
3	34.	34	44.25	44.5	28	32.5	32.5	43	42.75
4	32.5	32.5	45	45	29	37	37.25	45	45.5
5	35.5	35.5	48.5	48.5	30	33	33	44.5	44.5
6	29.5	29.75	38.5	38.75	31	32	32	45	45
7	29.5	29.5	40.5	40.5	32	31.5	31	41.5	41.5
8	31	31	41	41	33	29.5	29.5	38.5	38.5
9	28.25	27.75	41	40.5	34	32	32	44	44
10	32.5	32.5	40	40.25	35	32	32.5	46	46.5
11	31.5	31.5	40.5	40.75	36	31.5	31.25	42.5	42
12	30.25	30.5	42	42.	37	33.5	33.5	45.3	45.5
13	34.5	34.5	41	41	38	30.75	30.5	42.5	42.5
14	32	32.5	42	42.25	39	36	36.25	46.25	46
15	32	32	42.5	42	40	32.25	32	43	42.5
16	31.75	32	43.5	43	41	31.5	31.25	44.25	44
17	31.5	31	41	41	42	33.	33.	45	45.5
18	29.5	29.5	46.25	46.25	43	33.5	33.5	44.75	44.75
19	32.5	32.25	43.5	43.5	44	31.	31.	44.25	44
20	34.5	34.25	44.25	44.5	45	31.5	32	43.5	43.75
21	30.5	30.5	40.5	40	46	34	33.5	45	45.5
22	32.	32.	43.5	44	47	31.5	31.5	44	44.25
23	34	34	46	46.25	48	38	37.5	40	39.5
24	31.5	31.5	41.5	41.5	49	32.5	32.5	45.5	46.5
25	28.25	28.5	41.25	42.25	50	33.75	33.5	48	47.75

Fourth, that in cases in which the right femur was longer than the left, the maximum difference observed was 9 mm.; while in cases in which the left was longer than the right the maximum difference was 10 mm.

Fifth, that the mean excess in length of the right humerus over the left was 4.9 mm. and that of the left over the right was 2.6 mm.; while the mean excess in length of the right femur over the left was 4.2 mm. and that of the left over the right was 4.7 mm.

The tabulated series of 50 cases obtained from the Anatomical laboratory of University and Bellevue is given in Table II.

Class I.—Femurs equal, humeri equal in same subject in Nos. 4, 5, 7, 8, 13, 18, 19, 24, 25, 30, 31, 33, 34, 43, fourteen cases in all. Frequency 28 per cent.

Class II.—Femurs equal, humeri unequal, Nos. 12, 17, 19, 25, 32, 38, six cases. Frequency 12 per cent.

Class III.—Femurs unequal, humeri equal, Nos. 1, 2, 3, 10, 11, 15, 21, 22, 23, 27, 28, 37, 44, 47, 49, 42, sixteen cases. Frequency 32 per cent.

Class IV.—Femurs unequal, humeri unequal. Type A: Greater length of homolateral humerus and femur. Cases 6, 16, 29, 35, 36, 40, 41, 45, 48, nine cases. Frequency 18 per cent. Type B: Contralateral cases, Nos. 9, 20, 26, 39, 46, five cases. Frequency 10 per cent. Total 28 per cent.

Unequal humeri: Right longest in 13 cases; left longest in 8 cases.

Unequal femora: Right longest in 12 cases; left longest in 20 cases.

Mean difference, humeri, 3.3 mm.; mean difference, femora, 3.8 mm. Maximum difference, humeri, 5 mm.; maximum difference, femora, 1 cm.

TABLE III.—Long Island Hospital.

No. of Subject	Humerus		Femur		No. of Subject	Humerus		Femur	
	R	*L*	*R*	*L*		*R*	*L*	*R*	*L*
1	31.5	31	45.5	45	13	37	37	43.5	43
2	34	34	46	46	14	33	33	43	43
3	27	27	38	38	15	33	34	43	43
4	33	33	49	49	16	31	30.5	42	42.5
5	33.5	34	43.5	44	17	31	31	40	40.25
6	35	34.5	45	44.5	18	24	23.75	42.5	42
7	34.5	34.5	45.5	45.5	19	34	34	45	45.25
8	30.5	30.5	41	41	20	35.25	35	42	41.75
9	30	30.5	39.5	39	21	31.5	31.5	43	43
10	30	30	42	41	22	29	29.75	39	40.5
11	32	31	44.5	45.5	23	30	30	43	43
12	32	32	42	43	24	27.75	27	37.25	36.5

The Long Island cases were measured in a manner similar to that employed at Columbia, a rule with sliding arm being used. The series may be analyzed as follows:

Class I.—Femurs equal, humeri equal, Nos. 3, 9, 15, 2, 4, 8, 16, 22; eight cases. Frequency 33 per cent.

Class II.—Femurs equal, humeri unequal; one case, No. 15. Frequency 4 per cent.

Class III.—Femurs unequal, humeri equal, Nos. 11, 13, 23, 14, 18, 20; five cases. Frequency 22 per cent.

Class IV.—Femurs unequal, humeri, unequal. Type A: Greater length of homolateral humerus and femur, seven cases. Reference, 1, 5, 6, 7, 19, 21, 23, 25. Type B: Greater length of contralateral humerus and femur, three cases. Reference, 10, 12, 17.

Inequality of Humeri.—The right was longest in 8 cases, and the left was longest in 4 cases.

Inequality of Femurs.—The right was longest in 8 cases and the left longest in 6 cases.

When the right humerus was longest the mean difference was 1 centimetre, and when the left humerus was longest the maximum difference was 1 centimetre. The left humerus the same. The right humerus being longest, the mean difference was 5.9 mm., and 7.5 mm. when the left was in excess. The mean difference when the right femur was the longest was 5.6 mm., and when the left was in excess 7 mm. Maximum humerus, 1 cm.; maximum femur, 1 cm.

A summary of the three series is as follows in percentages: Femurs equal, humeri equal, Columbia, 1.8 per cent.; Bellevue, 28 per cent.; Long Island, 33 per cent. It thus appears that the highest percentage in which we could expect symmetry of the extremities is 33 per cent.

In Class II, in which the humeri were unequal but the femurs equal, the Columbia percentage was 22.2 per cent., Bellevue 12 per cent., and Long Island 4 per cent.; therefore in about 20 per cent. of the cases unequal humeri would be accompanied by equal femurs, and Dr. Wight's rule would therefore not apply.

In Class III, where the femurs were unequal and the humeri were equal, the percentages were as follows: Columbia

11.1 per cent., Bellevue 32 per cent., Long Island 22 per cent.; that is to say, although the femurs were unequal, the humeri would be equal in about 22 per cent. of these cases, so that again Dr. Wight's rule of comparison of humerus with companion femur would be fallacious. Taking the two classes together, Class II and Class III, and the rule would not apply in at least 40 per cent. of the cases.

In Class IV, in which both upper and lower extremities were unequal, the percentages were: Columbia 64.8 per cent., Bellevue 28 per cent., Long Island 44 per cent., giving an average of 45.6 per cent., in which both upper and lower limbs were asymmetrical.

In the whole series of cases the right humerus was longest in 55 cases, and the left in 23 cases. This preponderance of length of the right over the left humerus may readily be accounted for by righthandedness. Correspondingly, the right femur was longest in 39 cases, the left femur in 44 cases. This does not entirely agree with Dr. Wight's conclusions that the left femur is the longest where inequalities exist in so large a proportion of cases as his measurements on the living subject indicates; still in this series of carefully measured cases, the left femur is longer than the right in 44 out of 83 cases. The companion tibiæ were unfortunately not measured; but from a comparison of these figures it is quite probable that where one femur was longer than another the corresponding tibia was also longer,—and if we assume that the maximum and mean differences of the tibiæ were proportionate to the femoral differences, the total inequality of the lower limbs would be nearly double the inequalities of the femora alone. The average maximum difference of the three series where the humeri were longer was 7.2 mm., about three-quarters of a centimetre, and the mean difference, 6.5 mm. Where the femurs were unequal, the average maximum difference was 9.8 mm., and the average difference 8.6 mm.

One hundred and twenty-eight cases were measured in the entire series, and in 99 of these cases the femora were unequal.

It therefore appears that symmetry of the femora in the same individual is exceptional and that asymmetry is the rule. At least in 78 per cent. of the cases recorded, asymmetry existed, and in cases of asymmetry the average disproportion in length of the femur alone as measured on actual specimens of bones was very nearly 1 cm., and if we add a variation in the companion tibiæ of but ½ cm., the total variation on the ordinary surgical measurements would be not far from 1½ cm. It may readily be seen, therefore, that if the short bone were fractured the apparent shortening would be very much greater than the actual shortening, and if sufficient weights were put on the injured limb to make the femora equal, something that they were not originally, the ends of the bones might be actually separated by a distance which might lead to non-union. The best method of preventing such an untoward circumstance at present seems to be in the routine employment of the Röntgen photograph, for there seem to be so many sources of error possible in using sound bones in the same individual as a means of comparison, that no fair deduction could be drawn therefrom. The present methods of measuring the lower extremities are unsatisfactory in the extreme. The anterior superior spine, except in very lean individuals, is a very uncertain quantity, and no two men are likely to agree on what is the lowest point of the internal malleolus. The umbilicus has been discredited as a point from which to measure, but it has occurred to the author that possibly the sternal notch might be available, the lower point of measurement being the plane of the heel in line with the internal malleolus, this plane being determined by the apposition of any plane surface to the foot. The upper end of the tape is fixed at the sternal notch and not moved for the measurement of either side, the lower end of the tape being swung first to the plane of the right heel and then to the plane of the left. In order to determine which of the three methods was least open to individual error, my assistants, Drs. E. B. Fiske and Russell W. Rome, made a series of 312 measurements of paired femora in 52 male subjects, neither being aware of the figures obtained by the other.

These measurements were most carefully made with the following results: (1) The average variation between the measurements made by the two men, anterior superior spine to malleolus, was 1.07 cm. (2) In measuring from the umbilicus to a plane surface in apposition with the plane of the heel the average variation was 1.24 cm. (3) In measuring from sternal notch to plane of heel, the average variation was 1.10 cm. (4) The smallest variation was from sternal notch to right femora, being a mean of 1.04 cm. The greatest variation was on the left side, umbilical measurement, 1.27 cm. (5) In 312 measurements there was exact agreement in only 40 cases, a little over 12 per cent. of all cases measured.

It is my impression that the measurement taken from the sternal notch to the plane of the heel, as indicated by a plane surface in apposition therewith, will prove to be a method least open to error. The following precaution, however, must be adopted. The measurements must be made at the same period of respiration. The plane surface in apposition with the heel must be parallel in each case, as a slight inclination in either direction would mean an error in the measurements.

THE TRANSPORTATION OF SKIN FLAPS FROM ONE PART OF THE BODY TO ANOTHER AND FROM ONE INDIVIDUAL TO ANOTHER.*

BY JOHN M. T. FINNEY, M.D.,

OF BALTIMORE, MD.,

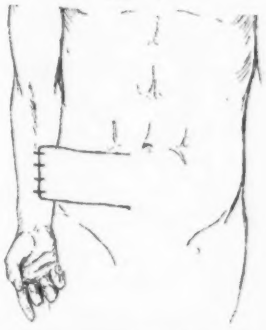
Associate in Surgery in the Johns Hopkins Hospital.

AMONG the most ancient and best known surgical procedures which have been handed down to us are the classical methods of repairing defects in the integument by means of the transference of portions thereof from one part of the body to another. These methods are so familiar that a discussion of them at this time would be not only out of place, but foreign to the purpose of this paper. We will limit ourselves, therefore, to a consideration of those methods alone which have to do with a transfer of skin flaps from one part of the body to another, without the preservation of the original blood supply to those flaps. We shall also exclude from consideration those methods which deal only with the skin itself, in whole thickness or in part, such as the well-known procedures of Reverdin, Thiersch, Wolff-Kraus, etc. We wish to consider that class of case in which it is desirable, in order to repair losses of substance, to transplant something more than the skin, *e.g.*, the subcutaneous fat, fascia, periosteum, etc., as the case may be. Obviously the range of applicability of these latter methods is limited, as the advisability of retaining the original blood supply where possible is so apparent as to need no further comment. Now and then, however, a case presents itself for relief, in which owing to the particular location, or to such extensive losses of substance from trauma of one sort or another, chiefly scalds or burns, that it is impossible to make use of the older methods, because of lack of sufficient or suitable tissue in the immediate neighborhood of the part to be restored.

* Read before the American Surgical Association, June 5, 1909.

Such a condition was present in the person of Roberta M., a girl of seven, who was referred to me by Dr. Rees of Charleston, South Carolina. In this case, owing to extensive burns involving the upper anterior portion of the body, the chin was drawn down upon the chest, and the lower part of the face frightfully scarred and disfigured. The lower lip was entirely missing, except for the mucous membrane which was everted, exposing the lower teeth and gums. Saliva was continually drooling from the mouth. The front of the neck, chest and upper extremities were covered with dense cicatrices which rendered it manifestly impossible to obtain suitable skin flaps from anywhere in the vicinity. In our extremity, we finally hit upon the following plan as the only one which seemed at all feasible.

FIG. 1.



Transporting the skin and subcutaneous tissue from the abdomen to the forearm.

A flap six by four inches, with its base toward the middle line was dissected up from the anterior surface of the abdomen. This flap included the skin and subcutaneous tissue down to the aponeurosis of the rectus and external oblique muscles. An incision four inches long was then made upon the anterior surface of the forearm. The free border of the abdominal flap was inserted into this incision and the skin edges carefully united. Gutta-percha tissue was placed over the denuded surface of the abdomen after the edges had been approximated as closely as possible by other silk sutures. The arm was fixed to the patient's side with a broad strip of adhesive plaster, passed around the arm of the patient and then around her body. The arm was left in this position for two weeks. The dressing was then removed and the circulation in the flap found to be good through-

out. The pedicle of the flap was now divided, severing it from its abdominal attachment. The arm was then flexed and the patient's hand brought up to and placed upon her head, allowing the free end of the flap to be adjusted to the cheek, which had been freshly denuded for this purpose, after reflecting upward the flap of everted mucous membrane. The skin flap, now receiving its blood supply from the forearm, was fixed in place by sutures between its free border and the skin of the cheek and left in place for another two weeks. At the end of this time, the circulation having become established between the cheek and the flap, its attachment to the forearm was severed, and the repair

FIG. 2.

Transporting the flap from the forearm to the cheek.

of the lower lip completed by attaching the mucous membrane to the upper free border of the abdominal flap which now composed the lower lip. A few sutures were placed in the lower edge of the flap attaching it to the skin of the neck. Care was taken to avoid any tension or any more interference with the circulation than was possible. A slight sloughing of the flap occurred at one corner but not enough to affect materially the result, which in the end was most satisfactory. Massage of the new lip was begun as early as the healing would allow, and aided much in loosening up the surrounding tissues.

I had occasion to make use of this same procedure in another case very similar to the one just reported. This patient, a child of four and one-half years, had been severely

burned about the lower part of the face and upper part of the body in front, and presented a condition almost identical with the case just reported. Exactly the same procedure was carried out. Here, however, the result was not so satisfactory owing to the youth and extreme restlessness of the child. Considerable sloughing of the corners of the flap occurred, although the central portion took nicely and materially improved the patient's appearance. Our experience with this second case and a subsequent one to be referred to later, leads us to believe that such operative procedures as these requiring fixation of the parts, are not applicable to young children.

FIG. 3.

The flap fixed in its final place, restoring lower lip and covering chin.

Extreme youth, therefore, we would regard as a definite contra-indication to these operations.

In looking over the literature of the subject, the only references I can find to similar operations are as follows:

In 1888 Dr. G. F. SHRADY of New York, in a personal communication to Sir W. McCormick and reported by him, gives an account of a very ingenious method by which he was able to cover up a "most unsightly gap in a girl's cheek. The arms are folded in a comfortable manner. A suitable-sized flap is dissected up from the anterior surface of the arm with its base either up or down, as desired, and the free end of the flap is stitched into a slit made for the purpose in the radial side of the forefinger. Later the flap is cut loose from the arm and then transported by the finger to the desired locality. This case resulted very satisfactorily."

So far as I am aware, this case was never published elsewhere by Dr. Shrady.

In 1895 Dr. W. S. Halsted reported to the Johns Hopkins Hospital Medical Society a method which he had made use of in a patient suffering from extensive burns over the chest, neck, and arms, in whom he had transferred a skin flap from the back and side of the neck around to the front. Dr. Halsted characterized his method as a "waltzing" of flaps and described it as follows: "None of the original attachments of the last flap which we used have been preserved. The flap has twice been twisted upon itself, first upon a small pedicle of skin (original tissue we may call it), and secondly upon a little broader pedicle of cultivated cicatricial tissue. The flap has probably made a complete revolution."

The result in Dr. Halsted's case was most satisfactory.

In 1901 STEINTHAL reported an operation almost identical with the one performed by us. The operation in his case was done "to relieve a very extensive loss of skin from the face which had been excised to relieve an extraordinarily progressive lupus. Attempts had previously been made by means of the Thiersch method to relieve the deformity. The results, however, were not satisfactory. The greater portion of the nose had been destroyed and it was necessary to do a complete rhinoplasty. The surrounding skin being useless for this purpose, it was necessary to secure a flap from elsewhere." In order to do this, Steinthal cut from over the sternum "a tongue-shaped skin-periosteal flap of suitable size. After cutting and preparing the flap, the breast wound was almost closed with sutures, and the broad edge of the flap grafted into the forearm through a corresponding incision made over the lower end of the radius. The flap was sutured into place, and the arm fastened in a comfortable position by a bandage. The flap was kept from drying out by a thick boric ointment dressing. Four days later the nourishment bridge on the breast was cut through. A few days later the flap, being at this time well nourished, was attached to the root of the nose and the arm fixed against the head in a comparatively comfortable position, with plaster of Paris bandages. After ten days, the flap was separated from the arm and a new nose made from the hanging flap, which was now luxuriantly granulating. The result was most satisfactory, some trimming up of the flaps being necessary later."

These reported cases demonstrate beyond doubt the feasibility of the method and establish the principle that in selected cases where for one reason or another it is impossible to secure flaps in some one of the usual well recognized methods, use may be made of this principle with a fair prospect of success.

In rare instances, however, the conditions may be such that it is impossible to make use even of this method which has just been described. In such cases where one cannot secure suitable flaps from the patient himself, one is forced to look elsewhere, namely, to the person of another. Such a case presented itself to the writer since the first portion of this paper was written.

The patient was a girl 5 years of age, also from Charleston, South Carolina, who came to me through the satisfactory result obtained in the first case just reported. This child had been run over by a street car some months previously. The right leg had been so badly injured as to necessitate amputation at about the middle of the thigh. The left foot also had been badly crushed and the integument of the foot had sloughed off, leaving the foot entirely devoid of skin up to the malleoli. The child who, at the time of the accident had been in robust health, was now, owing to the accident and resulting disturbances, much reduced. Attempts had been made by her physician to cover the foot with Thiersch grafts, but unsuccessfully. These grafts had been cheerfully given by an older sister of the patient, and had been cut from her thigh.

Owing to the poor condition of the patient, and the fact that one leg had been lost, and that there was no possible chance of securing flaps from the other, nor, indeed from any other portion of the patient's body, it was decided to attempt the direct transplantation of skin flaps from another person. The idea was proposed and the same sister who had previously given the Thiersch grafts volunteered to supply the other. The method of procedure was as follows Under ether, a flap, seven by five inches, consisting of skin and subcutaneous fat and having its base upward, was raised from the outer surface of the donor's thigh. The patient's foot which had been freshly denuded for the purpose was inserted between the flap and the raw surface left after it had been dissected up. The flap was large enough to cover completely the plantar surface of the foot and was held in position by stitches through its free border and the edge of the skin above the patient's heel. A few interrupted sutures were placed on either side, wrapping, as it were, the flap around the denuded sole of the foot of the patient. Patient and donor were

held in this position by adhesive strapping and plaster of Paris bandages, holding the legs of the two in apposition and parallel to each other, with their heads in opposite directions. They were put to bed with the head of one at the head of the bed, and the head of the other at the foot. The two were surprisingly comfortable, and I feel sure the flap would have taken well, had it not been necessary, owing to the extreme restlessness of the patient, who as was said before, was only five years of age, to cut them apart earlier than had been intended. She was a spoiled child and wilfully added to the pain and discomfort of her older sister by moving her foot as much as possible when she felt so disposed. The two were kept tightly bound together in this fashion for ten days. I did not feel justified in keeping them together longer, owing to the needless pain inflicted by the patient upon her sister, who bore it most heroically. At this time the circulation in the flap appeared excellent, except at the very tip, and it had firmly adhered to the foot of the patient. Upon dividing its pedicle, however, after a few days the circulation began to show signs of failing, and the flap softened and soon completely disappeared.

Here again, as has been previously noted in the beginning of this paper, owing to the extreme youth and restlessness of the patient, the operation was prevented from being a success. The idea, however, I believe to be perfectly feasible and, under proper conditions, capable of being carried to a successful issue. I had supposed that this was a unique case, as no reference in the literature could be found to any similar one. We did find, however, that in 1865 Hamilton had suggested the possibility of such a thing, and had actually proposed it in one case, but no one could be found who would furnish the necessary tissue. A personal communication from Dr. F. B. Lund, of Boston, accompanied by a photograph reports a similar case performed by him in August, 1908. I quote as follows:

> Michael M., aged 19 years, single, had his foot caught in an elevator, so that the entire sole of the foot was crushed off. He was admitted to the City Hospital on August 4 and on August 25 had a perfectly clean granulating area covering the entire sole of the foot from the base of the toes to the tip of the heel. He had a fairly large foot, and it seemed to me that if a sufficiently large flap were taken from the other leg it would

FIG. 4.

FIG. 5.

CASE I.—Showing result after operation.

denude it too much, so the experiment was tried of taking a flap from the abdomen of his brother, who was about his age and size. The brother was placed in a bed which was brought up to the foot of Michael's bed, so that the sole of Michael's foot lay across his brother's abdomen. On August 25 they were both etherized, Michael's foot was curetted and a flap turned up from his brother's abdomen below the umbilicus, the long axis being transverse, of course, to the body. The flap was sutured to the inner side and posterior and anterior borders of the raw surface on Michael's foot. Then the brother was bolstered up and confined by straps attached to the bed in various directions with a sheet across him, and Michael's foot was tied down so that he could hardly move it. The use of plaster of Paris was thought of; but it presented some difficulties, so the idea was abandoned.

When the boys came out of ether, they began to be very uncomfortable and used language of the most violent kind toward each other, and almost came to blows. The following day, the brother had a temperature of 103, rapid respiration and signs of consolidation at the base of one lung. He was very uncomfortable in his position, and the question of cutting them apart was considered, but it was decided to leave them together. The foot was dressed two days after the operation, and looked healthy. The brother from whom the abdominal flap had been taken was very uncomfortable and hard to manage. He refused nourishment and grew very weak, and on September 4, I did not dare to leave them together any longer, and although it was only the sixth day after the operation, I cut off the abdominal flap. It looked healthy, and bled a little from the cut edge, but in a few days began to get gangrenous and finally melted away.

Although the results in both Dr. Lund's case and my own were not satisfactory, still, as will be observed, the conditions in each case were very unfavorable to the production of a satisfactory result. Under proper conditions, I feel sure it will be found entirely possible to transfer in this manner from one individual to another, flaps of desired size and thickness.

BIBLIOGRAPHY.

Hamilton: N. Y. Jour. of Med., Sept., 1854, p. 169.

Shrady, G. F.: Rep. by Sir W. McCormick, Birmingham Med. Review, vol. xxiv, p. 241, 1888.

Halsted, W. S.: Johns Hopkins Hospital Bulletin, vol. vii, p. 25, 1896.

Steinthal: Beitrage f. klin. Chir., vol. xxix, p. 485, 1901.

Lund, F. B.: Personal communication, April 8, 1909.

MASSIVE KELOID OF FACE AND HANDS.*

BY CHARLES A. PORTER, M.D.,

OF BOSTON, MASS.

Surgeon to the Massachusetts General Hospital.

THIS remarkable case of keloid of the face and hands is reported chiefly to put the photographs upon record, and to show the present result after numerous plastic operations, skin grafts, and spontaneous healing. Although the X-rays were conscientiously tried over several periods there was no benefit.

This patient entered the Massachusetts General Hospital, on March 10, 1905, in the service of Dr. A. T. Cabot, whose assistant I was at that time. Dr. Cabot performed the first operation on March 20, 1905; since then Dr. F. G. Balch has operated five times and I myself six times.

History.—Stephen Calabro; Italian; aged 19. Ten months ago patient's face and hands were severely burnt in an explosion in a fireworks factory. He was treated for three months at the Quincy Hospital. Five months ago the region about one of his eyes was skin-grafted at the Carney Hospital, since which time the scars have been steadily growing. *Examination*: Patient's face presents massive keloid extending from the hair-line on the forehead over the whole face, including both ears. A small portion of the right cheek is visible, the eyes appearing as slits in the midst of the exuberant overgrowth. Slight impairment in hearing; vision in left eye interfered with; mouth can only be opened half an inch. There is excessive keloidal growth on the backs of both hands and lower third of the forearms, the fingers being hyperextended, twisted, and distorted. In numerous places the keloidal tissue is eroded, with some foul discharge from the sulci between adjacent lobules.

Operation, March 20, 1905, by Dr. A. T. Cabot; rectal anæsthesia. Incision over the symphysis of the lower jaw, down to the subcutaneous tissue, with removal of keloid over right side

* Read before the American Surgical Association, June 5, 1909.

of chin and part of cheek. Several necrotic areas were found deep in the tissues, in the transitional zone between keloidal and normal subcutaneous fat. On the left, the keloidal mass overhanging the lower jaw was excised, opening an abscess cavity which contained several drachms of pus. Dry dressing; daily X-ray treatment until moderate degree of dermatitis was induced. By April 4 the epidermis was growing very slowly, but there was no return of keloid; distinct improvement in the mobility of the lower lip was evident. On April 18, a typical erysipelas developed which lasted about ten days.

Operation May 31, 1905, by Dr. Porter. The thick plaques of keloid were dissected off in masses from cheeks, forehead, nose, left ear, and lips; in many places down to the subcutaneous tissue. Hemorrhage was very free. This operation required a dozen to fifteen knives, as the tissues were so hard. There was profuse discharge of pus for many days, but at the end of a fortnight the epidermis began to spread in rapidly, and the patient was discharged on June 14 much relieved.

Re-entry December 20, 1905. The keloidal masses have returned but not to their former extent. The left eye is obscured and the eyelids are deformed by scar tissue. A keloid the size of a silver dollar has formed upon each shoulder and another one above the sternoclavicular notch.

Operation December 29, 1905, by Dr. Porter. The recurrent keloid on the right side of the face was shaved off. Wedge-shaped piece cut out from right eyebrow and the edges brought together. A similar wedge from beneath the lower lid was excised and sutured. The keloid at inner canthus of the eye was removed and skin-grafted from the leg. Other grafts were applied over the raw tissues about lower jaw. The grafts took well and by January 17, 1906, only a small area over the lower jaw on the left was uncovered by epidermis. On January 23, more pin-point grafts applied to granulating areas on face. February 1, 1906, another attack of erysipelas of both face and hands.

Re-entry March 6, 1906. Face considerably improved; left eye open and useful, though there is slight cicatricial ptosis and ectropion.

Operation March 14, 1906, by Dr. Balch. Bilateral operation for ectropion; excision of scars with Thiersch grafts from thigh.

By March 28 both grafts, which had taken, showed a tendency to shrink with slight recurrence of ectropion. Keloid forming on area from which graft was taken from thigh.

Operation April 2, 1906, by Dr. Balch. An attempt was made to separate the fingers by excision of the dense cartilaginous-like tissue. Plastic operations were done; the thumb partially freed from scar; but it was impossible to secure proper skin flaps for the denuded area. Hand was dressed with rubber tissue and dry dressing. On April 4 raw surfaces grafted under cocaine, but grafts failed to grow.

Operation April 9, by Dr. Balch. A large crescentic area of scar was removed from beneath the left lower eyelid; a Wolff graft was removed from the right side of chest and fitted to the denuded area. Graft took well under the left eye. In the meantime, there was considerable recurrence of the keloid over the face.

On May 4, under ether, Dr. Porter excised two crescents of the keloidal tissue which overhung both eyes. The wound was then sutured, raising both eyebrows. The recurrent keloids underneath the eyes were completely dissected out with a large keloid which covered the whole right cheek. The growth over the nose was removed down to the subcutaneous fat. Two brothers and a friend were then circumcised and the prepuces used for Wolff grafts, the grafts having been previously punched to allow for drainage, and then sutured in position over all denuded areas. These heterogeneous grafts grew well at first and by the end of the fourth day showed definite evidence of re-established circulation, but on the ninth day all turned black and in a few days separated. On May 28, Dr. Balch rubbed the granulations with gauze and then applied three Thiersch grafts, which, however, failed to take. During the summer the X-rays were used again. The keloidal tissue beneath the lower lids contracted steadily but showed little tendency to increase outward.

In March, 1907, Dr. Balch did plastic operations on two or three of the fingers, separating the webs and loosening up the index finger, and again in April, attempted to gain flexion of the thumb by freeing the extensor and flexor tendons and removing the head of the proximal phalanx of the thumb. Primary union, but no marked improvement in motion.

On June 24, Dr. Porter dissected out the cartilage of the

FIG. 1.

FIG. 2.

Condition on entrance to hospital, March 10, 1905.

FIG. 3.

Condition of hands, March 10, 1905.

FIG. 4.

FIG. 5

Condition, May 27, 1905.

FIG. 6.

FIG. 7.

Condition, November 4, 1905.

FIG. 8.

FIG. 9.

Condition, January 6, 1906.

FIG. 10.

May 6, 1906, showing result of excisions and preputial grafts on May 4, 1906.

FIG. 11. FIG. 12.

Present condition, June 1, 1909.

right ear, which was involved in the keloidal growth; Thiersch grafts were applied. The left ear was also freed, as was the lower lip. Skin grafts were applied to all raw surfaces, and the mass above the suprasternal notch was excised and the edges sutured.

Operation July 12, 1907, by Dr. Porter. The cicatricial tissue which was causing hyperextension at the right wrist was removed and the area skin-grafted. The thumb was freed and a graft applied between it and the index finger. The webs which formed between the middle and adjacent fingers were pierced obliquely from behind forwards and downwards, and through the opening a piece of rubber dam was drawn. The right ear was freed at its top and the raw surfaces were skin-grafted. By August 15 the skin had grown about the rubber setons at the base of the fingers, and the web was cut under cocaine.

On August 24, 1908, Dr. Porter removed a thick mass of scar tissue holding the ear to the scalp. Another operation was performed for recurrent ectropion of the left eye, a crescentic excision being made and a Wolff graft from the thigh applied; graft took well.

On September 14, 1908, re-entered; operation by Dr. Porter. Further freeing of the right ear and removal of keloidal masses; areas skin-grafted and the patient discharged September 30, 1908.

Résumé.—After many operations, the photographs show the present result. There has been a gradual but distinct abatement of the tendency to form keloidal tissue. The forehead is covered by shiny, movable skin, resulting partly from natural healing and partly from skin grafts. There is some keloid about the deformed ears, but both show evidence of their presence. The nose and cheeks are fairly normal, but there is still some ectropion in spite of the numerous operations. The hands have been improved so far as ability to grasp objects with the thumb is concerned, but dorsal hyperextension of the fingers still persists, as shown in the photographs. X-rays seem to have been of no value.

TRANSACTIONS

OF THE

AMERICAN SURGICAL ASSOCIATION.

Annual Meeting held at Philadelphia, Pa., June 3, 4, 5, 1909.
The President, CHARLES B. G. DE NANCRÈDE, in the Chair.

I. ADDRESS OF THE PRESIDENT: THE END RESULTS AFTER TOTAL EXCISION OF THE SCAPULA FOR SARCOMA.

DR. CHARLES B. G. DE NANCRÈDE, of Ann Arbor, Mich., gave the Annual Presidential Address; his topic was as named above. For the address in full see page 1.

II. CHRONIC INTESTINAL STASIS.

MR. W. ARBUTHNOT LANE, of London, Eng., read a paper on Chronic Intestinal Stasis, for which see page 190.

DR. J. C. BLOODGOOD, of Baltimore, called attention to the X-ray examination as a method of diagnosis which he thinks will be more frequently used in the future. He presented a rough sketch of the condition found in a recent patient, a full report of whose history will be published later; he also referred to a former case which is now well for two years without having had a resection.

DR. T. W. HUNTINGTON, of San Francisco, considered the principal significance of the subject under discussion was the idea of the prevention of the conditions. He was of the opinion that these cases of enteroptosis, bearing especially upon the large bowel, could be avoided by careful attention in early life to the emptying of the bowel, and that this accumulation is due usually to a definite cause giving rise to sufficient irritation to interrupt the peristaltic wave, as, for instance, in cases of occult appendices.

DR. ARTHUR DEAN BEVAN, of Chicago, was of the opinion that Mr. Lane's suggestions were rather radical. He said he

should insist upon a condition which should be described absolutely as that of intestinal obstruction, before he would feel warranted in undertaking such an operation as an anastomosis or the removal of a part or the whole of the colon. He considered the subject of chronic constipation one which should be dealt with jointly by the internist and the surgeon.

Dr. J. F. Binnie, of Kansas City, said that in a number of these cases he had done a cecostomy with very fair temporary results, although he has been unable to learn the ultimate results.

Dr. John B. Roberts, of Philadelphia, stated that he understood Mr. Lane to advocate surgical operations in these cases only when all other means had failed, and he then believed this surgical interference should be prolonged and radical.

Dr. Maurice H. Richardson, of Boston, called attention to the fact that he had reported two or three cases of chronic intestinal obstruction. He believes the surgery of the large intestine should not begin by at once operating for obstinate and chronic constipation, although early exploration in cases of chronic constipation will relieve many pathological conditions which can be treated as easily as the simple incision of a band. It is his firm opinion that an exploration should be made in all cases of obstinate intestinal obstruction, whether called constipation or obstruction, and that such serious and dangerous operations as the complete resection of the large intestine should be avoided.

Dr. Wm. B. Coley, of New York, said that while believing in conservatism he did think that too often these cases were allowed to go too far without surgical interference. He called attention to the fact that nine such cases operated upon for volvulus of the sigmoid at the Massachusetts General Hospital had terminated fatally. He reported a case of his own operated upon on the ninth day for acute obstruction. The abdomen was opened under cocaine and the giant sigmoid fastened to the abdominal wall, and a large amount of liquid fæces evacuated through a tube in the bowel. In a week the patient began to have natural passages by the rectum; at the end of two weeks the wound had healed. The symptoms then reappeared, and in a short time he had increasing distention. Dr. Coley did not think it wise to resect the sigmoid but introduced a small silver tube into an opening for the escape of gas, and this the patient has been wearing for a year.

MR. LANE, concluding the discussion, said that in the discussion no mention had been made of what he considered the most important points in the paper, the toxic results of auto-intoxication. He believes it is growing to be more the general opinion that the intestinal tract is no longer to be only treated by drugs from above or enemas from below.

III. THE RELATION OF MESENTERIC DISTORTION TO INTESTINAL OBSTRUCTION.

A paper upon the above subject, by DR. JOSEPH D. BRYANT, of New York, in the absence of the author, was read by title. It is published in full beginning at page 229.

IV. THE FECAL ORIGIN OF SOME FORMS OF POSTOPERATIVE TETANUS AND ITS PROPHYLAXIS BY PROPER DIETETIC OR CULINARY MEASURES.

DR. RUDOLPH MATAS, of New Orleans, read a paper with the above title, which he summarized as follows:

1. Notwithstanding the vast increase in our knowledge of the etiology, pathology and prophylaxis of tetanus since the discovery of the drumstick bacillus of Nicolaier, twenty-six years ago, a certain—not full determined— number of postoperative deaths from this infection occurs in seemingly clean surgical cases, a circumstance which has not been satisfactorily accounted for.

2. While it has been fully and irrefutably demonstrated that the regional liability of the exposed parts of the body to tetanus (*i.e.*, feet, hands, legs, forearms, arms, face, neck, etc.) is directly proportional to the degree of surface contact with tetanus-bearing (tetaniferous) matter (earth, manure, dust), the origin and regional distribution of accidental and postoperative tetanus in the concealed parts of the body (protected from surface exposure) has not been sufficiently investigated or recognized. Surely not sufficiently insisted upon in accounting for postoperative deaths in which the rules of surgical asepsis have been apparently well observed.

3. Abundant experience has shown that while the risk of tetanus infection can be absolutely eliminated in all operations upon sterile tissues in which a rigorous postoperative asepsis can be maintained until healing has occurred, this liability cannot be removed in those regions in which postoperative asepsis cannot be secured.

4. In order of importance next to the feet and hands and other exposed parts of the extremities, the injuries and surgical operations in those regions of the body which are most exposed to fecal contamination, are the most liable to tetanic infection. In this category we will place the anorectal region, perineum, female genito-urinary tract, male genitals (especially scrotum), lower pelvic region (including buttocks, sacrococcygeal region), groins, thigh, knee, upper leg, on their posterior surfaces especially; after operations on the intestines, artificial anus, etc., in all of which postoperative fecal contact is either constant or unavoidable on account of proximity to the intestine. In considering this topographical distribution we are excluding the direct but unconscious transmission of fecal matter to distant parts of the body by the soiled fingers of the patient himself or of his attendants.

5. The careful attention to the sterilization of instruments and the disinfection of the hands compelled by the rules of modern surgical, obstetric and veterinary practice, have enormously reduced the liability to tetanic infection, even when those parts of the body are involved which are most exposed to fecal contact, by eliminating the direct inoculation of wounded surfaces with contaminated instruments and hands. However, the occasional postoperative deaths which occur from time to time in the practice of competent and clean surgeons clearly point to another source of danger which is not dependent upon defects of technic or contaminated material (*e.g.*, imperfectly sterilized catgut), but to other sources of infection outside of and apart from the operative act itself, which have not been adequately appreciated.

6. This hitherto unrecognized or disregarded factor in the causation of postoperative tetanus, at least in regions liable to fecal contact, is the direct contamination of the alimentary canal and its contents with living tetanus bacilli and their spores, swallowed in raw, uncooked vegetables, berries and other fruits which are cultivated in fertilized or manured (*i.e.*, tetanized) soil (Robinowitsch, Kolle and Hetsch, Miquel and Cambrier, Kolle and Wassermann, Thalmann, Hecker, et al.).

7. It may be a mere coincidence, but it is a fact, that in all the cases of postoperative tetanus occurring after operations in regions liable to fecal contact, which have been investigated by the author (two in his own practice), the patients had eaten

copiously of uncooked vegetables immediately before the operation. The vegetable menu in these cases correspond with the laboratory findings in regard to the vegetables found most frequently contaminated with tetanus germs and spores, viz., celery, lettuce, chicory, watercress, cabbage (cold slaw), radishes, turnips, carrots, tomatoes and other green vegetables, strawberries, blackberries and other berries and fruits which are grown in the soil or brought in contact with it and which are largely consumed raw in an unavoidably contaminated state.

8. The tetanus bacillus and its spores are known to survive the passage through the intestinal canal of the domesticated animals, especially the herbivorous horse and cow, and the dung of these animals is a perpetual culture medium for the tetanic bacillus, swallowed constantly with the grass of the pasture and the fodder of the stable; not only are the bacilli ejected alive, but their virulence and activity are probably intensified by their temporary residence in the favorable conditions of the lower intestinal tract (Sormani). This survival of the tetanus germ in a virulent state is fully demonstrated by the experiments of Sormani. Sanchez Toledo, Veillon and Hoffmann, et al., who demonstrated that the diluted excrement of the horse and cow, injected subcutaneously and otherwise, will kill rabbits in from five to six days with all the symptoms of this disease. These and other authors have fully demonstrated that the spores of the drumstick bacillus resist the action of the digestive juices; it has also been demonstrated that the tetanus-laden fæces of the healthy horse and cow are capable of producing fatal tetanus when brought in contact with wounded surfaces in these animals.

9. In view also of the fact that 5 per cent. of all normal men harbor the tetanus bacillus or its spores in an active state in the intestinal canal, and that the percentage of contaminated individuals is increased to 20 per cent. in hostlers, stablemen, dairymen, drivers, etc. (Pizzini), the possibility of tetanus from fecal contact must always be kept in mind, especially when operating upon the anorectal region, perineum and genito-urinary organs of both sexes, in unprepared subjects.

10. The author fully recognizes that the normal defences of the organism against intestinal infection are, in healthy individuals, usually sufficient to protect it, even if the living tetanus bacillus has been freely introduced into the alimentary canal with

the ingested food. It is only through the salutary and preservative influence of the protective mechanism, which largely neutralizes the most virulent infection in the alimentary canal, that we can account for the great numbers who escape when operations are performed in the recognized tetanogenic regions. It is evident, however, that even if tetanus infection is a comparatively rare postoperative sequence, it is well worth the observance of the simple precautions required to avoid this deadly accident. Precautionary measures would be more than justified if only one in ten thousand operative cases could be saved from the almost certain death which follows when this form of inoculation occurs after operation.

11. In accordance with the preceding statements, and his own convictions, the author has taught and insisted in his own practice, since his last and second postoperative death from tetanus (perineoplasty and hemorrhoids) occurred five years ago, that no patient should be brought to operation without antitetanic preparation, whenever an operation is to be performed upon parts in which fecal contamination is unavoidable (hemorrhoids, fissure, fistula, stricture, etc.).

12. This antitetanic preparation is very simple, and consists in: (*a*) purgation, three days before the operation; (*b*) the suppression of all raw, uncooked food, especially green vegetables, berries and other fruit (for the same period of time before the operation). In emergencies when dietetic preparation is impossible, 10 c.c. of tetanus antitoxin are injected subcutaneously at the time of the operation, while the patient is still under the anæsthetic.

Dr. John E. Owens, of Chicago, mentioned a case of a woman past middle age suffering from tetanus; she had received no wound, but two or three days before the attack she had had a tooth pulled. She was fond of working in the garden and was also fond of fresh celery, of which she had been eating freely, and it was therefore thought that her tetanus might have been caused by indulgence in this vegetable.

Dr. Robert W. Johnson, of Baltimore, referred to a paper on this subject of tetanus which he had read at a previous meeting of the association, and said he did not recall reporting a single case occurring from fecal origin, although there were a number of postoperative cases following herniotomies, appen-

dectomies, hysterectomies, etc. These cases were assumed to have been produced by infection through the catgut used. He said that he had seen a case of tetanus resulting from rectal operation where instead of trismus as an early manifestation there were rectal spasms. He considers it surprising, in view of the facts mentioned by Dr. Matas, that he has not more frequently met with cases of tetanus after rectal operations.

Dr. W. H. Hutchings, of Detroit, said he had recently had an opportunity of treating three cases of postoperative tetanus, one of which followed an abortion. In one of the cases, that of a crushing injury to the hand in which a skin-grafting operation was done, the patient did not develop tetanus for a month after the injury; he considers this an evidence that tetanus spores can remain latent for a long time.

Dr. Joseph Ransohoff, of Cincinnati, said that in his experience he had never seen a case of tetanus following a rectal operation. He mentioned a case in the practice of another surgeon, which he had seen, where instead of a trismus there was an open mouth, which he considered a rather rare condition.

Dr. Maurice H. Richardson, of Boston, said he had never seen a case of postoperative tetanus, and considered it a very rare condition. He therefore thought it would be rather a radical procedure to follow Dr. Matas' suggestion of using antitetanic serum in all rectal cases.

Dr. A. G. Gerster, of New York, said that in thirty-two years of surgery he had encountered not one case of postoperative tetanus.

Dr. Beverly MacMonagle, of San Francisco, said that in an experience of over thirty years he had seen but one case of postoperative tetanus, and that was a case of trachelorrhaphy in which catgut was used. In consideration of Dr. Matas' statements he thought his own experience unusual, as he frequently operated among the poor class of Italians, under most adverse conditions in their own homes, and yet had never had a tetanus resulting after operation.

Dr. Edmond Souchon, of New Orleans, referred to a case upon which he operated for hemorrhoids and the patient died on the eighth day from tetanus; also a case in which the cæcum was resected which was followed by death from tetanus.

Dr. Willy Meyer, of New York, mentioned a case of interval operation for appendicitis, after which the patient developed

tetanus but made a good recovery. The catgut used was supposed to be the cause of the tetanus, but Dr. Meyer is of the opinion that it might have been caused by what he calls the pseudotetanus bacillus, which is sometimes found in the appendix, according to the literature on the subject.

Dr. F. H. Gerrish, of Portland, referred to two cases of postoperative tetanus, one resulting after ligation of hemorrhoids, and the other after an operation upon a necrosed tibia. It is his opinion that cases of tetanus come in waves, some years it being quite prevalent, and then there being few instances in other years. He will be careful in his future intestinal operations to see that his patients eat no raw food or vegetables for some days previously.

Dr. J. Collins Warren, of Boston, considered tetanus to a certain extent to be a tropical disease, and that latitude exerts some influence upon the growth of the bacillus; also that occasionally it is epidemic.

Dr. Stanley Stillman, of San Francisco, had had no personal experience with tetanus, but remembered being taught by Dr. Lane, a former member of the association, the great danger of tetanus following ligature operations for hemorrhoids, and as a result of this teaching he had always been most careful in the preparation of his patients for operation.

Dr. A. Vander Veer, of Albany, could recall no case of tetanus following operations upon the rectum in his experience. He referred to an editorial regarding the disposal of sewage in Los Angeles and Pasadena, which criticized very severely the method of using the sewage for irrigation of the poor farms and other lands where they raised vegetables which grew above the ground and which are eaten in an uncooked state. He is not at all opposed to the prophylactic dose of antitetanic serum, which he uses frequently.

Dr. George E. Brewer, of New York, saw no objection to the use of the prophylactic dose of antitetanic serum, stating that it was used in all cases of injured hands and feet in the accident department of the hospital with which he was connected.

Dr. Dudley P. Allen, of Cleveland, said that some summers ago at the Cleveland Hospital they had a number of cases of tetanus from the use of the toy pistol; every one of these cases which were opened and packed recovered, but those which were not so treated died early from tetanus.

Dr. C. B. G. de Nancrède, of Ann Arbor, mentioned the fact that there were certain portions of the country where tetanus was practically never encountered, while in other portions it was very prevalent. There is a great deal of it in the country round about Ann Arbor, and there is a standing order to Dr. de Nancrède's internes to give a prophylactic dose of antitetanic serum in all cases where the wound is of a kind likely to lead to tetanus. For eleven years Dr. de Nancrède has been in the habit of warning his students of the dangers of unripe fruit as possible sources of tetanus, and is rather surprised that so few believe in this origin of the disease.

Dr. Robert G. Le Conte, of Philadelphia, reported a case occurring fifteen years ago in the practice of one of his friends. The patient had undergone an operation for the repair of the cervix and perineum, and on the seventh or eighth day developed tetanus, from which she died. He mentioned the fact that the Pennsylvania Hospital of Philadelphia had for many years following the Fourth of July many cases of tetanus to treat, but that since using the immunizing dose of the antitoxin there had not been a single case.

Dr. Matas, concluding the discussion, said that the preparation of the patient to which he referred in his paper was not the preparation preliminary to operation, which most surgeons were very particular about, but a preparation extending back for some three or four days, in order that the bowels might be thoroughly cleaned out with no possibility of a fecal contamination following operation. He believed that where such preparation was not possible it was a wise precaution to use the immunizing dose of the antitoxin. He stated that warm latitudes seemed to predispose to the disease, especially in times of peace, while in times of war it seemed to make but little difference. He suggested that another reason why tetanus was not so prevalent in northern latitudes was that the soil there was not so laden with the tetanus bacillus.

V. THE HISTOPATHOLOGY OF GOITRE.

Dr. Francis W. Shepherd, of Montreal, read a paper in which he gave the results of a microscopical study of over fifty cases of thyroidectomy, for which see page 84.

Dr. William S. Halsted, of Baltimore, stated that at one time he had performed some experiments on dogs for two years

at a time, and found that when once the hypertrophy of the glands was produced by the ordinary cause it did not change for at least two years.

Dr. Charles H. Mayo, of Rochester, said that his own cases bore out in the main the report given by Dr. Shepherd, and that the more thyroids he examined the more simply he reduced the pathology of the condition. He looks upon the term colloid, as found in a thyroid, as a complement to the real secretion, and not the secretion itself.

Dr. Rudolph Matas, of New Orleans, spoke regarding the thermic development in operations upon the thyroid glands. He cited the case of a recent patient whose temperature an hour after partial resection of the gland went up to 105.°. He suggested the use in these cases of high temperature, of Blake's tubes in the rectum, by which ice-water is administered in large quantities. This has always been most successful in his hands.

Dr. Francis J. Shepherd added that he found a high temperature after operation chiefly in exophthalmic cases, but in simple goitre it was caused by serum, and when this was removed the temperature would fall.

VI. THE PARATHYROID QUESTION.

Dr. Charles H. Mayo, of Rochester, Minn., read a paper with the above title, for which see page 79.

Dr. John H. Gibbon, of Philadelphia, referred to a case of tetany occurring in a patient from whom he had removed the entire right lobe of the thyroid. The condition developed on the fourth day after operation, became very bad, and the patient's mental condition grew distressing; calcium was conscientiously tried, as was also the feeding of the patient with the parathyroid of beeves, but with no effect. A number of months later the patient was reported as much worse, and then nearly a year later she was said to have practically recovered. Dr. Gibbon did not know the ultimate outcome of the case.

Dr. William S. Halsted, of Baltimore, said that he felt there was practically no danger of tetany following a case operated upon by Dr. Mayo's method. He considers one reason why tetany occurs so seldom is because so infrequently both lobes of the thyroid gland are removed. He cited one case of tetany which was treated most successfully by lactate of calcium.

He also mentioned some experiments upon the parathyroids of dogs, where it was found possible to keep the dogs alive for some time on one transplanted parathyroid.

Dr. Francis J. Shepherd, of Montreal, said he had never seen a case of tetany following an operation upon the thyroid gland. In all cases of partial excision of the thyroid glands he carefully examines for the parathyroids, and frequently finds them embedded in the inside of the gland.

Dr. Maurice H. Richardson, of Boston, said that the only cases of thyroids which he had to deal with were those sent to him from practitioners who were afraid to deal with them on account of their size, and that he had never seen a case of tetany nor a parathyroid body.

Dr. L. L. McArthur, of Chicago, reported a fatal tetany following a case of goitre removal with resection of both lobes, in which the parathyroid bodies, which were demonstrable on the right side, were removed. The patient presented symptoms of tetany on the fifth day; thyroid extract was administered, and he went home with his wound healed and the tetanic symptoms in subsidence at the end of two weeks. Ten days later, or twenty-four days after the operation, having been in the meanwhile around the house, he was suddenly again seized with the tetanic convulsions, and died in ten hours. Dr. McArthur ascribed this to a pure tetany independent of any infective process.

Dr. N. B. Carson, of St. Louis, reported a case of removal of the thyroid gland in which some time later the patient developed an immense keloid along the line of the scar.

Dr. Charles H. Mayo thought that the resemblance to the thyroid gland found by Dr. Halsted in removing the parathyroid gland which had been transplanted in one of the dogs upon which he was experimenting, would show the association of function of these various glands. He said that, as Dr. Shepherd had stated, the parathyroid body was sometimes found in the capsule of the gland, although this was not its usual position.

VII. EXCISION OF THE LARYNX FOR CARCINOMA.

Dr. James Bell, of Montreal, read a paper with the above title, for which see page 92.

Dr. W. W. Keen, of Philadelphia, referred to a paper read by him when he was President of the Association, the title of

which was "Total Laryngectomy," no one feature of his method being new, but simply a novel combination. The two features he insisted upon were the exaggerated Trendelenburg position and the avoidance of any preliminary tracheotomy, and the keeping of the patient for two or three days subsequent to the operation in the Trendelenburg position. He stated that his first patient is now well at the end of eleven years, and can be heard at a distance of thirty feet without any artificial larynx.

Dr. George E. Brewer, of New York, stated that the mortality in these cases, according to his experience, agreed with those reported by Dr. Bell, but that he followed a different form of technic. His first case was done nearly eleven years ago, after the method of Dr. Keen. Following that one success he had many disastrous results, in all of which cases he did no preliminary tracheotomy. He now does a preliminary tracheotomy ten days prior to operation, exposes a large amount of trachea, packs with iodoform on either side with a view to creating dense adhesions which act as a bar to the descent of infection. He removes the larynx from below upward, closes the pharynx and does not lift up the trachea. Since following this plan he has had no operative mortality, and the cases have been more comfortable than ever before. With regard to feeding, he introduces a nasal tube in the lower portion of the œsophagus and begins feeding from the start with concentrated foods, just after the patient comes out of ether, and water in six hours.

Dr. N. B. Carson, of St. Louis, suggested that rectal anæsthesia employed in these cases would add much to the comfort and chances of recovery of the patient.

Dr. Roswell Park, of Buffalo, reported a death following laryngectomy. He used subnitrate of bismuth instead of iodoform; the patient did well for two or three days and then died. An autopsy was performed and every particle of mucous surface was found covered with bismuth paste; the bismuth had become mixed with saliva, then with the mucus, and had spread itself over the patient's breathing surface so as to completely choke off all possibility of æration.

Dr. George W. Crile, of Cleveland, reported 20 total laryngectomies, the first 8 performed without fixing the trachea, the last 12 along the lines described by Dr. Brewer. There were 2 immediate fatalities in the first 8 and none in the last 12. The

results were quite satisfactory. The first case is living after 16 years; one patient died in 5 years from pneumonia; one living after 4 years; one after 3 years, and the remainder are all recent operations.

Dr. Bell said that he thought it unnecessary to fear infection extending down the neck if the patient were kept in the Trendelenburg position and the wound not too completely closed. He considered the feeding question most important, but does not look with favor upon the performance of a gastrostomy, as suggested by some operators.

VIII. FURTHER OBSERVATION ON TRANSFUSION; WITH A NOTE ON HÆMOLYSIS.

Dr. George W. Crile based this further report on transfusion on recent experience. The vein makes a better cuff than the artery, and he emphasizes the importance of dilating the end of the artery before drawing it over the cannula.

It has been found, contrary to common belief, that kinship is of no special advantage, any normal blood doing as well. The condition of the heart is the most important consideration in transfusion. When there is a heart lesion with compensatory hypertrophy the muscle is working near its maximum and its normal factor of safety may be lost.

In deep anæmia there is impairment of the heart muscle. If in such a case blood be transfused rapidly and under full pressure, there is striking improvement, but great caution is necessary, for dilation may follow with stagnation of the circulation. This condition is met by carefully adjusting the rate of flow and by noting the first sign of dilation, when the flow is checked or stopped. Cardiac stimulants and observation of change in heart dulness are the effective prophylactic measures. The most effective active measure consists in the rhythmic compression of the chest, which forces the blood from the thorax, improving the circulation.

As to clinical results there is no modification of previous conclusions, viz.: In pernicious anæmia, toxæmia, certain drug poisoning, leukæmia, Hodgkin's disease, carcinoma and uræmia, no benefit has been observed. A case of hyperthyroidism was apparently benefited. A case of pellagra, transfused from an immune donor had a rapid convalescence. If done early, trans-

fusion is a specific for an acute hemorrhage. In suitable cases it has been of great value in the prevention and relief of shock. Certain amount of encouragement has followed transfusion in tuberculosis.

In operative surgery, cases where hemorrhage and anæmia exist, or where the patient is reduced by disease or starvation so that an operation is out of the question, transfusion will make it possible. The technic of transfusion is exacting, and may be difficult, and is rarely necessary in the routine surgical work.

In regard to hemorrhage, it is, first, but one form of action between the blood of one individual and that of another; secondly, that if there is hæmolysis *in vitro* it by no means necessarily follows that there will be hæmolysis *in vivo*. This is especially so in tubercular cases where hemorrhage has occurred *in vitro*, but transfusion was performed with no unfavorable results.

Hæmolysis is a valuable aid in the diagnosis of acute tuberculosis, the reaction occurring more frequently than in cancer. In the latter, hæmolysis usually occurs in the earlier stages, rarely in the later.

Dr. George E. Brewer, of New York, said that one remark of Dr. Crile's would be appreciated, and that was that even direct transfusion is attended with a good many mechanical difficulties. He thought one found transfusion much more complicated when tried upon a human being than when done on animals. He has devised some glass tubes which if placed in boiling paraffin before introduction, the blood will not clot on them, thus assuring a steady stream from the donor to the donee.

Dr. William S. Halsted, of Baltimore, referred to experiments made some thirty years ago, in centripetal transfusing of the animals, and wished to know Dr. Crile's opinion of this method of transfusion where the patient had a weak heart. He also stated that somewhat the same method as suggested by Dr. Brewer had been tried at Johns Hopkins Hospital with silver tubes. He spoke of another method of transfusion, which, while not considering it as good as Dr. Crile's, he thought still had its uses. Two tubes are used, one for the vessel of the donor and one for the vessel of the donee, and these can be quickly joined together.

Dr. John H. Gibbon, of Philadelphia, said he had used Brewer's tubes with a great deal of satisfaction, while he had not found Crile's so easy of manipulation.

Dr. David Barrow, of Lexington, wanted to know in cases where shock was dependent simply upon the question of centripetal embarrassment, whether Dr. Crile had ever been able to demonstrate the value of the transfusion of blood.

Dr. Crile said he wished to recommend Brewer's method, which seemed simpler than his own. In reply to Dr. Halsted he stated that in his opinion centripetal transfusion was of the utmost importance in cases of weak heart. With regard to Dr. Barrow's query he stated that the transfusion of blood overcomes to a great degree the circulatory depression of shock.

IX. TUBERCULOSIS OF THE PERICARDIUM CURED BY INCISION AND DRAINAGE.

Dr. Charles L. Gibson, of New York, stated that operation, if any, for the relief of tuberculous pericarditis must be rare, but the fact that a cure was obtained in the case he presents makes it worthy of record.

The case was as follows: Male, negro, aged 26, whose past history was without features except for an ischiorectal abscess three months ago. Family history for tuberculosis is negative. For past two months has had a heavy cough with slight expectoration; for past two weeks dyspnœa has been so bad that he could not lie down, sleeping in a chair; swelling of the feet noted six days ago. Physical examination showed a man of fairly large frame, fairly well nourished; breathing with some difficulty and with an expiration grunt. Heart percusses 1½ inches to *right* of sternum and 6 inches to left. Sounds of poor quality and hard to hear. Considerable bronchitis. Five days after admission pericardium was aspirated in fifth space and 18 ounces of opaque, yellowish fluid were obtained. Finally it was decided, as there was not marked improvement in the patient's condition, that operative interference was indicated. Attempts were made at local anæsthesia, but these attempts, because of the lack of self control of the patient, were found in vain. Chloroform was then given to the point of unconsciousness, followed by ether. An incision was made in the long axis of the left fifth cartilage, a bit of the rib and also the fourth cartilage removed. The greatly distended pericardium was seized between two Kocher clamps and a two-finger incision gave issue to a great volume of pus, probably a quart. The pulse was

perceptibly weakened by the flow, and it was therefore blocked. The sac must have contained three quarts. The pericardial edges were sutured to the soft parts and a rubber drainage tube passed into each lateral cul-de-sac. The subsequent drainage was profuse. Since operation the patient's condition has been poor, and he is now again in the hospital as an inmate of the tubercular ward, the presence of a tubercular process in the lung being now manifest; tubercle bacilli were not found till recently, notwithstanding almost daily examination of the sputum. The pericardial healing has persisted, evidences of an adhesive process being manifest. That such a severe process can result in a cure in the face of an advancing tubercular diathesis is considered most remarkable, and certainly makes surgical measures in such cases seem justifiable.

X. VISCERAL PLEURECTOMY.

Dr. Alexander Hugh Ferguson, of Chicago, after defining visceral pleurectomy (decortication of the lung, or Fowler's operation) to be removed by operation of the thickened visceral pleura in cases of chronic empyema, referred briefly to the work of Fowler (1893), Delormè (1894), Reclus (1894), Gallet (1895), and his own in 1896, as the earliest work done of this kind. He explained the advantages of a partial visceral pleurectomy, clearing out the apex of the lung while the ribs were being removed (Schede), but cautioned against doing too much at one sitting. The indications for the operation were stated somewhat as follows:

1. Suppurating cavity remaining after drainage and various rib resections had been performed.

2. The absence of tubercular foci in the lung that is bound down, or in other parts of the body, lend favor to the procedure being a success; but even these conditions need not deter the surgeon when the patient can withstand the operation. Once the drain on the system caused by the suppuration is stopped, the patient has a better chance to overcome the tuberculous infections wherever they may be.

3. When amyloid disease of the internal organs is beginning to manifest itself, then the operation should no longer be delayed.

4. When it becomes clear that in a certain case the cavity had no further tendency to close, then this operation should be seriously considered.

The pathology, both macroscopic and microscopic, of the visceral pleura removed was very carefully and minutely given. In describing the operation, Dr. Ferguson gave preference to a mid-axillary incision, and clearing away all cicatricial tissue, stumps of ribs, etc., in his way to get at the visceral pleura. The offending covering of the lung is boldly cut through to sound lung tissue and cut away en masse if possible. Should the lung have a tendency to bulge out it should be compressed with moist gauze. After cleaning out the apex of the cavity the operation should not be completed if the patient shows signs of weakening, for the major part is now done, and the rest of the thickened pleura may be exsected afterwards under local or gas anæsthesia.

Dr. Ferguson had operated on six cases, and obtained complete success in every instance. In the preparation of cases of chronic empyema for operation, and in carrying out the after treatment, the doctor gave great praise to 33 per cent. of bismuth subnitrate in white vaseline used as a paste to fill all sinuses and cavities as invented and practiced so extensively by Dr. Emil G. Beck, of Chicago. It has been proven that Beck's paste improves all such cases and cures many of them, thus often rendering it unnecessary to do a major operation like visceral pleurectomy.

Dr. Ferguson presented a skiagraph of a case operated on by this method, which showed but a small strip of lung tissue left, a pneumonectomy having been practically performed, and the patient made an excellent recovery.

XI. OPERATIVE TREATMENT OF TUBERCULOSIS OF THE LUNGS.

Professor Dr. P. L. Friedrich, of Marburg, Germany, read a paper with the above title, for which see page 135.

XII. ŒSOPHAGOGASTROSTOMY AFTER INTRATHORACIC RESECTION OF THE ŒSOPHAGUS.

Dr. Willy Meyer, of New York, read a paper with the above title, for which see page 175.

XIII. RESECTION OF THE RIBS COMBINED WITH EXTERNAL PRESSED IN THE TREATMENT OF TUBERCULOSIS OF THE APEX OF THE LUNG.

Dr. Leonard Freeman, of Denver, Colorado, read a paper with the above title, for which see page 145.

XIV. A CONSIDERATION OF SURGICAL PROCEDURES DESIGNED FOR THE RELIEF OF PULMONARY TUBERCULOSIS.

Dr. Charles A. Powers, of Denver, read a paper with the above title, which will be published in a future number of the Annals of Surgery.

XV. EMPYEMA THORACIS.

Dr. Albert Vander Veer, of Albany, New York, read a paper with the above title, for which see page 158.

XVI. THE TREATMENT OF POSTOPERATIVE FISTULÆ AND ABSCESSES FOLLOWING OPERATIONS FOR EMPYEMA.

Dr. Albert J. Ochsner, of Chicago, Illinois, read a paper with the above title, for which see page 151.

XVII. THE OPERATIVE TREATMENT OF HEART WOUNDS.

Dr. Charles H. Peck, of New York, read a paper with the above title, for which see page 100.

The following discussion on thoracic surgery ensued.

Dr. John E. Owens, of Chicago, reported the case of an engineer who was struck in the chest by a piece of molding from the cab of his train in a collision. The piece of molding was 12 feet long. This struck the engineer over the third rib just external to the heart, passed upwards and inwards, coming out at the second rib. He ultimately recovered and returned to work.

Dr. A. G. Gerster, of New York, considered the suggestions of Friedrich very valuable additions to the technic of thoracic surgery. He referred to a recent case of his own, in which the patient, having had a pulmonary tuberculous cavity of the apex suffered a perforation into the pleural cavity. A limited removal of the ribs was done without much effect, and then ten ribs were resected, beginning from the first to the tenth, the approach to the cavity being in the axillary line. The main difficulty was in the resection of the four or five upper ribs. He considers it important to note that in this instance there was no difficulty in removing the first rib. The patient is doing well and an ultimate recovery is looked for.

Dr. John B. Murphy, of Chicago, said that the principles

underlying all operations on the thoracic cavity were pulmonary rest and drainage of cavities, to be secured in the early stages by intrathoracic compression with air or gas. If the lung is put at rest cicatrization results and then repair. He also alluded to the pathology of empyema.

Dr. George Tully Vaughan, of Washington, spoke especially with reference to surgery of the heart, stating that in the last year he had had another case recover after suture of the heart. Statistics show that gunshot wounds of the heart give a smaller mortality than stab wounds, which seems rather surprising; also that the highest mortality followed wounds of the right ventricle.

Dr. Richard H. Harte, of Philadelphia, referred to cases of suture of the heart, and said he always had had the greatest difficulty in the introduction of sutures in wounds of the auricle especially.

Dr. Joseph Ransohoff, of Cincinnati, with regard to cases of empyema, said he knew of no class more satisfactorily treated than the acute empyemas in young subjects, which usually heal very promptly and do not become chronic unless allowed to do so before operation. The neglected cases are the ones in which difficulty is encountered. He referred to Fowler's method of removing the pleura from the surface of the lung, which he had followed several times with good results. The subject of the differential pressure apparatus was broached, and the suggestion made that where it was impossible to use this apparatus the lung be grasped as soon as the chest wall is opened, brought into the wound and attached to the wound edges with sutures. He considers a suddenly developed pneumothorax an exceedingly serious thing, often causing death.

Dr. Joseph A. Blake, of New York, spoke with regard to the technic of operations upon the thorax, referring to recent experiments made by Drs. Greene and Janeway. In carrying out the work of the positive pressure apparatus the idea was suggested that the old intralaryngeal method had advantages in that an artificial apnœa could be induced, inhibiting the patient's respiratory movements so that the operator is not embarrassed by the excursions of the diaphragm. They have therefore devised a valve which works rhythmically, increasing the pressure 8 to 10 mm. in the chamber; the patient soon stops breathing of his own volition and the respiratory movements of the chest become

more quiet, thus making operation much easier of performance.

Dr. Samuel Robinson, of Boston, referred to some experimental work he had done in the experimental laboratories in Marburg with regard to artificial pneumothorax, and also with regard to the thoraplastic operation; he performed 26 thoraplastic operations upon dogs, with a resulting vastly improved technic.

Dr. William S. Halsted, of Baltimore, said that there was reason for hope of cure in cases of aneurism of the abdominal aorta by partial constriction of this vessel, even when the band must be applied above the renal arteries, and cited a case which seemed to prove this assertion. Dr. Halsted has applied an aluminum band to the thoracic aorta about 7 cm. above the diaphragm with the hope of influencing the progress of and relieving the excruciating pain caused by a large aneurism of the upper abdominal aorta, with satisfactory results. He discussed minutely the experimental surgery of the lungs upon dogs, with special reference to the technic, saying that in 21 consecutive thoracotomies there was only one primary infection of the thorax. Positive pressure was employed in all his experiments by means of a very cheap but most effective apparatus devised by Dr. Gatch.

Dr. Charles A. Powers, of Denver, said he had been particularly impressed by the work which had been done abroad in cases of surgical interference in pulmonary tuberculosis, especially with reference to nitrogen insufflation in suitable cases. He believes there will be great developments along this line in the near future.

Dr. Albert Vander Veer, of Albany, briefly mentioned a paper upon the subject of surgical interference in pulmonary tuberculosis presented by him some years ago. He also referred to a case of recent date in which the thickened pleura was dotted quite extensively with phosphatic deposits, and in which he removed almost completely the entire pleura.

Dr. Alexander Hugh Ferguson, of Chicago, emphasized a simple procedure which he had been using for five or six years, namely, capillary drainage for serous effusion of the lungs and for cases of empyema. He said he had also followed this method of capillary drainage with satisfaction in cases of very large ovarian tumors.

Dr. Willy Meyer, of New York, with regard to empyema spoke in favor of the employment of differential pressure, citing

some very interesting cases. With regard to lung extirpation he said he had found that the important point was the proper treatment of the stump of the bronchus, which he treats on the same basis as the appendix stump; his records show that of 18 total left pneumomectomies 15 have recovered, 3 deaths being due to accidental conditions; in 21 operations there were 17 recoveries; in the removal of the lobes in 6 cases there were 5 recoveries. With regard to the œsophagus, he said there was nothing more difficult than the maintenance of asepsis, and he was of the opinion that all methods demanding suture were to be abolished. He believes efforts should be directed to the implantation of the œsophagus into the stomach rather than to bringing it into apposition with the stomach.

XVIII. THE PREVENTION AND TREATMENT OF THE SEQUELS OF PERINEAL PROSTATECTOMY.

Dr. James E. Moore, of Minneapolis, Minn., read a paper on this subject. He said:

Perineal prostatectomy is a life-saving operation, but a grave one, and should not be undertaken lightly. It is accompanied by a mortality rate of a little over 6 per cent. and over 17 per cent. are either complete failures or are followed by some sequel that makes the operation far from satisfactory. Owing to the age and bad condition of these patients mortality rate must be high. The nature of the operation is such that complications and sequels are bound to occur, but at the present time the mortality rate is too high and the sequels too common. According to the latest statistics 7.4 per cent. of these operations are failures, but in competent hands the patient should always experience sufficient relief to justify the operation, though he may not be completely cured. When a patient continues to suffer pain and tenesmus after the operation it is usually due to a pocketed bladder, diseased kidneys or an incomplete operation.

The prostate is an important sexual organ, and its removal by any route or method is sure to have a decided effect on the procreative powers of the patient. Owing to the reticence and untruthfulness of patients it is impossible to state how often this sequel follows, but it is certain that it occurs so frequently that every patient who is comparatively young in years should have this possible contingency stated to him before the operation is performed.

Injury to the rectum is probably the most frequent complication, often causing death, and when a patient survives he is liable to have a urethral rectal fistula. Unskilful use of fingers, downward pulling by retractors and too slight packing with gauze are the usual causes, and by guarding against these causes this accident should be avoided. When the rectum is torn it should be immediately repaired. This will often fail, but succeeds often enough to justify the effort.

Stricture is a more common sequel than is generally believed, and is due to extensive removal of the prostatic urethra. We expect injuries to the urethra from other causes to result in stricture, and there is no reason why it should not follow this operation. Enough of the upper wall of the prostatic urethra should be preserved to secure an unbroken mucous surface extending from the bladder to the meatus. Extensive dissection of the perineum, especially when cross cuts are made, are conducive to stricture. Projecting portions of the urethra are sometimes left which obstruct the flow of urine by acting as valves.

Dribbling or incontinence is an occasional sequel of perineal prostatectomy and is due to injuries to the neck of the bladder and to the compressor urethræ muscles. Instruments introduced into the bladder to draw the prostate down should be used with the utmost care, lest they injure the neck of the bladder. The compressor urethræ is the important sphincter and should be preserved by entering the prostatic rather than the membranous urethra. The treatment of incontinence when once established seems to be hopeless.

Perineal fistula is a rare sequel and is usually due to the deposit of lime salts, the removal of which relieves the condition.

Epididymitis is an occasional sequel, but is usually of little consequence beyond the discomfort it causes, and is very often due to the injudicious passing of sounds.

XIX. SUPRAPUBIC PROSTATECTOMY.

Dr. Arthur Dean Bevan, of Chicago, Illinois, read a paper with this title.

Dr. Albert J. Ochsner, of Chicago, has been much impressed with the greater ease with which the prostate can be enucleated from above. With regard to the question of hemorrhage, he has been able to overcome this by attaching forceps to the capsule, bringing it down, passing in a rubber tube so that

the bladder would remain empty, then packing the capsule with gauze for twenty-four hours.

Dr. Alexander H. Ferguson, of Chicago, emphasized the great advantages of the perineal route in operations upon the prostate.

Dr. Joseph Ransohoff, of Cincinnati, while in favor of the suprapubic route, thought there were many points in favor of the perineal. He stated that he frequently did a partial prostatectomy, especially in young patients, which he believes can best be performed by the upper operation.

Dr. Maurice H. Richardson, of Boston, said that he did not believe it was possible, by either the perineal or suprapubic route, for the operator to tell how much damage was being done the urethra. He suits the method of removal to the exigencies of the individual case, and is not a firm adherent to either.

Dr. Stanley Stillman, of San Francisco, referred to the custom of Sir William Macewen, of performing the suprapubic operation in all cases in which the urine could be rendered fairly healthy, but where this could not be done he performed a double lateral lithotomy incision for purposes of drainage, followed by an interval of a week or ten days, during which time granulation tissue lined the incisions which were made, and the capsule of the prostate retracted; in that time the cut surface of the prostate protruded from the wound, the prostate itself was reduced in size, as the result of complete dissection, and ten days later he would shell out with his index finger each lobe of the prostate, with no bleeding and little danger of infection, insomuch as the urine had become fairly healthy in the interval. Dr. Stillman has followed this plan himself for two years with much better results than he ever obtained from other methods of prostatectomy. His preference is distinctly for the suprapubic operation where the urine is healthy, and for Macewen's method where the urine cannot be rendered healthy prior to operation.

Dr. Alexander Primrose, of Toronto, spoke in favor of the suprapubic route, and suggested the possibility of its removal by the transperitoneal route where the urine was healthy.

Dr. John B. Murphy, of Chicago, said he thought there was slight choice between the suprapubic and the perineal route in operating upon the prostate, and that each individual case should be carefully studied and then the method used which would seem to give the best results in that case.

Dr. Leonard Freeman, of Denver, was in favor of the suprapubic operation, having also had difficulties with the perineal. He says that he has been able to control the resulting hemorrhage in suprapubic operations, by firm packing of the wound.

Dr. James E. Moore, who is in favor of the perineal route, said he agreed with Dr. Murphy that the operation should be fitted to the case in hand. With regard to partial excision of the prostate he thought this at times was very good surgery. In answer to Dr. Richardson's query as to how to tell when the urethra was injured, Dr. Moore suggested the examination of the specimen after operation.

Dr. Arthur Dean Bevan, in spite of the statements made by the various men discussing the paper, was still of the opinion that the suprapubic route offered the best results. He commended the suggestion made by Dr. Stillman.

XX. FIBROID TUMORS OF THE UTERUS DEMANDING OPERATION.

Dr. Archibald MacLaren, of St. Paul, Minn., read a paper with the above title, for which see page 287.

Dr. Maurice H. Richardson, of Boston, said he thought there was more danger in a myomectomy than in a hysterectomy, although there was not much danger in either operation. He referred to several of his own cases.

XXI. THE TREATMENT OF TETANUS BY CHLORETONE.

Dr. Willard H. Hutchings, of Detroit, Mich., read a paper with the above title, for which see page 52.

Dr. Theodore A. McGraw, of Detroit, spoke with reference to the first case reported by Dr. Hutchings. In this case Dr. McGraw was most careful to thoroughly disinfect the wound, but in spite of these precautions the tetanus developed.

Dr. John B. Roberts, of Philadelphia, said that he considered the use of chloral, with the addition of the antitetanic serum, in cases of tetanus, very good treatment, but that he was unfamiliar with the composition of chloretone.

Dr. Thomas W. Huntington, of San Francisco, reported three fatal cases of tetanus in which chloral was used to the limit without other effect than producing the peculiar hue of the skin and somnolence during a portion of the period. He considered the report by Dr. Hutchings as a great advance in the treatment of these distressing cases.

Dr. Algernon T. Bristow, of Brooklyn, spoke with reference to the introduction of the antitetanic serum through the spinal cord, believing this to be indicated in cases of tetanus as much as in cases of meningitis. He also spoke highly of Rogers' method of the introduction of the antitoxin. He emphasized the importance of isolating the patient and keeping from him all noise and light.

Dr. De Forest Willard, of Philadelphia, stated that the only case of tetanus he had ever saved had been kept saturated for 28 days with chloral.

Dr. C. B. G. de Nancrède, of Ann Arbor, said he had been able to save a few cases of tetanus by the use of chloral, but had never seen the slightest effect from the antitoxin administered after the disease had started.

Dr. Nathan Jacobson, of Syracuse, said that he did not believe tetanus could be controlled in the least by amputation, citing instances to prove his belief. With regard to the method of introduction of the antitoxin, he found in a study of many cases that the method made little difference in the results. He has never used chloretone, although he has used chloral, which he does not consider particularly effective; he considers that a good deal of confirmatory experience is necessary to warrant the statement that in chloretone there has been found a means of arresting and curing these very acute cases of tetanus.

Dr. John E. Owens, of Chicago, referred to numerous cases of wounds of the hands and feet during the constructive period of the World's Columbian Exposition, in which no tetanus appeared. These wounds were opened rather freely, curetted more or less, then irrigated with 95 per cent. carbolic acid and a surgical dressing applied.

Dr. J. Ewing Mears, of Philadelphia, spoke of the remarkable success in the treatment of tetanus of puerperal origin which had been obtained in the hospital in Ceylon by the use of the antitetanic serum.

Dr. Hutchings said that chloretone was made from equal parts of chloroform and acetone, put in a test-tube, boiled for a minute or two, to which was then added some finely powdered sodium hydroxide. He considered that chloral had proven unsatisfactory. He agreed that the method of injection of the serum made little difference. He considers the isolation of the patient

most important. With regard to amputation he considers this has little effect upon the course of the disease.

XXII. TRANSPORTATION OF SKIN-FLAPS FROM ONE PART OF THE BODY TO ANOTHER.

Dr. J. M. F. Finney, of Baltimore, Maryland, read a paper with the above title, for which see page 324.

Dr. John B. Roberts, of Philadelphia, referred to a case in which a hand was grafted to a toe, and then a nose made out of it; also to a case in which the lip was repaired by flaps taken from the belly. In deformities of the chin and face in which the jaw is drawn down and the lip drawn out, he suggested the attaching of flaps down the back and then wrapping them in front of the patient's throat in the manner of a cravat, which method will sometimes allow the chin to be brought up into normal position.

Dr. Samuel J. Mixter, of Boston, referred to the cutting off of the circulation in the flaps by compression with forceps.

Dr. George Tully Vaughan, of Washington, spoke of several cases in which he had successfully employed heteroplasty, and of one unsuccessful case in which he tried to take a piece of skin from the thigh and graft it in the axilla.

Dr. William S. Halsted, of Baltimore, spoke of some experiments in transplanting the muscles in dogs from one dog to another, in which great difficulty was encountered in keeping the dogs bound together in order that the flaps might grow. These experiments had finally to be given up because of the impossibility of keeping the dogs quiet.

Dr. Finney said that the principle of transportation, the term suggested by Dr. Roberts, from one portion of the body to another, is what he wished particularly to emphasize in his paper.

XXIII. SURGERY OF THE LARGE INTESTINE.

Dr. William J. Mayo, of Rochester, Minn., read a paper with the above title, for which see page 200.

Mr. W. Arbuthnot Lane, of London, said that his only criticism of Dr. Mayo's technic was that he considered it much easier to divert the ileum into the sigmoid flexure, as then one could remove as much of the big bowel as desired. He found that if he ran the end of the ileum into the splenic flexure, at the end of some months he had to deal with a dilated ileum.

Dr. J. C. Bloodgood, of Baltimore, spoke with reference to the pathology of carcinoma of the large intestine. Anatomically and pathologically the evidence favors a very extensive resection of the large intestine because the tendency of the new growth is to infiltrate along the wall of the bowel and not into the mesentery with extensive involvement of glands. He suggests instead of the end-to-end anastomosis a large lateral anastomosis with the closed ends of the bowel protruding from the wound; this method has decreased his mortality rate greatly.

Dr. John H. Gibbon, of Philadelphia, referred to 10 cases he had had of resection of the colon for cancer and tuberculosis, one case of which is now well at the end of four years. In this case the colon was resected from the hepatic flexure to the sigmoid. Another case is well eighteen months after resection of the cæcum and ascending colon for cancer. He said that he had frequently made the mistake of doing an immediate resection in case of complete or partial resection where a drainage operation would have been better. The temptation to do the immediate resection and anastomosis is very great in some of these cases, but the operator should never yield to it.

Dr. Samuel J. Mixter, of Boston, suggested another method of anastomosis much like that suggested by Dr. Bloodgood—tying a tube into each open end of the bowel, and then by just a few stitches stitching the bowel together in the position suggested by Dr. Bloodgood, making a sort of double gun-barrel which is brought outside.

Dr. William J. Mayo thought the suggestion of Dr. Bloodgood an extremely good one which he should put into practice. He experimented with end-to-side anastomosis; three cases did well, and then two were lost from leakage. He thinks Dr. Bloodgood's method of bringing the ends of the bowel outside the wound would obviate the leakage.

XXIV. SUDDEN DEATH.

Dr. John Bapst Blake, of Boston, Mass., read a paper upon cases of sudden death occurring during physical exertion or psychic shock, for which see page 43.

Dr. Frederick H. Gerrish, of Portland, Maine, made reference to the first case in which chloroform was to be administered as an anæsthetic. The patient, just before the administration of the chloroform, expired on the table, and he is of the

opinion that had any of the drug been given it would have delayed its use as an anæsthetic for many years,—but as was very evident, it could not be blamed for the fatal result in this case.

XXV. ANEURISMS IN YOUNG PEOPLE.

Dr. Theodore A. McGraw, of Detroit, Mich., read a paper with the above title, for which see page 59.

XXVI. RESECTION OF THE SCIATIC NERVE; NEUROPLASTY.

Dr. Kenneth A. J. MacKenzie, of Portland, Oregon, read a paper with the above title, for which see page 295. He also presented the patient whose case was reported and demonstrated the end results of the procedures described.

Dr. Joseph C. Bloodgood, of Baltimore, said that the most interesting part of the case reported was its surgical aspect, as it represents one of the longest resections of the sciatic nerve on record. In his examination of sections of the tumor he was able to find the congenital residue of the multiple tumors now apparent on the patient. He said there is definite proof that many tumors of congenital origin of years' duration, clinically and histologically benign, may at any period become malignant.

Dr. Rudolph Matas, of New Orleans, referred to a case reported by him before the association in 1898 in which there was a huge tumor, even larger than that removed by Dr. MacKenzie. Dr. Matas did not, however, try to restore the sensibility of the parts, as Dr. MacKenzie had done so remarkably. Dr. Matas' patient developed a trophic ulcer of the heel, but after this had healed he was able, with the aid of a brace and a stick, to get along very well.

Dr. MacKenzie said that in trophic changes following injuries to the nerve, where it is impossible to restore motion and sensation, it is still possible, by making a flap operation, to prevent or stop the trophic disturbance.

XXVII. THE OPERATIVE TREATMENT OF FRACTURES.

Dr. John B. Walker, of New York, read a paper with the above title.

Mr. W. Arbuthnot Lane, of London, said he thought there was a certain amount of misunderstanding regarding the overlapping of fragments, stating that he had never seen a case where the shortening could not be completely overcome. He does not

consider wire very efficient in the suturing of fragments. He uses strong plates which will stand a strain of 448 pounds, and which are attached by small screws.

DR. T. W. HUNTINGTON, of San Francisco, laid special emphasis upon the value of the X-ray records in dealing with fractures, saying that he kept a complete record of every case, from start to finish.

DR. CAREY, of San Francisco, presented some X-ray plates of cases of fracture showing the perfect reposition obtained by means of the staple, an instrument recommended by Mr. Lane some years ago. His pictures also represented the small amount of callus produced when the fragments are perfectly reduced.

DR. CHARLES H. MAYO, of Rochester, Minn., said that in his opinion we should follow the suggestions of those who obtained the best results in the treatment of fractures, rather than continue with the old methods which often proved so unsatisfactory.

XXVIII. OBSERVATIONS ON THE INEQUALITIES OF THE RIGHT AND LEFT FEMORA.

DR. ALGERNON T. BRISTOW, of Brooklyn, New York, read a paper with the above title, for which see page 313.

DR. T. W. HUNTINGTON, of San Francisco, said that he had gone over several cases with regard to the inequalities of the right and left femora. He expressed his appreciation of Dr. Bristow's very carefully prepared paper.

DR. ALBERT VANDER VEER, of Albany, thought that Dr. Bristow's methods of measurement would be a great help in court in cases of malpractice.

DR. FREDERICK P. GERRISH, of Portland, Me., spoke of measurements made thirty years ago of students at Girard College, Philadelphia, by Dr. Martin, who used a very ingenious and accurate apparatus. He arrived at substantially the same results as Dr. Bristow, that there are great variations in the two lower limbs. He also referred to a method of measurement which he used. First, he adjusts the patient as precisely as possible upon a hard mattress or firm bed, having the head held with as nearly as possible perfect adjustment, have the patient take a tape between his front teeth exactly in the middle, and then he measures to the internal malleoli of the right and left side. By this method there is no chance of the shifting of the finger, as when the tape is held on the skin, and he has found it very useful indeed.

Dr. Robert W. Johnson, of Baltimore, said that in the taking of these measurements it was his opinion that the further one got from the pelvis the more likely they were to encounter changes from respiration and from the shifting of gas in the abdominal cavity. The measurements taken from the anterior superior spine would therefore appear to him to offer the best results.

Mr. W. Arbuthnot Lane, of London, referred to a report made by him some twenty-five years ago regarding this subject in bodies at the Guy's Hospital. With all the shortening in these cases he found the spine perfectly straight, which was Nature's compensation. With regard to the use of these measurements in cases of malpractice he could not agree with Dr. Bristow in their accuracy.

Dr. William W. Keen, of Philadelphia, said that he always measured, not from the anterior superior spine to the end of the malleolus, but just the reverse, attaching the fixed end of the tape at the end of the malleolus, but previously by careful manipulation determining what is the centre of the anterior superior spine and marking it. He then stretches the tape from the internal malleolus up to and over, but never touching, the skin over the anterior superior spine, thus reaching a much more accurate measurement than by any other method.

Dr. Richard H. Harte, of Philadelphia, said it was his opinion that no surgeon would rely upon simply one measurement, but would take them by various methods and check them up, thus being sure of the accuracy of his findings.

Dr. Bristow said that he had recently seen several cases in which it was absolutely impossible to bring the limbs together by any amount of weight. He considers the X-ray the best and practically the only method of determining the relative proportions of the two limbs. He emphasizes the fact that the disproportion in the limbs may be erroneously treated by the use of too heavy weights, probably with disastrous results.

XXIX. STRANGULATED RETROPERITONEAL HERNIA.

Dr. William B. Coley, of New York, reported a case of "Strangulated Retroperitoneal Hernia of the Intersigmoid Fossa," for which see page 238, and a case of "Interparietal Ventral Hernia at McBurney's Point," for which see page 246.

XXX. VESICO-INTESTINAL FISTULA.

Drs. F. W. Parham and Joseph Hume, of New Orleans, La., read a paper with the above title, for which see page 251.

XXXI. COMPLETE DETACHMENT OF THE FACIAL BONES FROM THE CRANIUM.

Dr. Charles A. Powers, of Denver, Colo., reported a case of the above character, for the description of which see page 73.

XXXII. MASSIVE KELOID OF FACE AND HANDS.

Dr. Charles A. Porter, of Boston, Mass., reported a case of remarkably massive keloid development, and presented a series of photographs depicting the condition. For this paper see page 332.

XXXIII. THE OLD AND THE BEGINNING OF THE NEW IN SURGERY.

Dr. J. Ewing Mears, of Philadelphia, presented an historical memoir with the above caption, which was read by title. For this memoir see page 23.

XXXIV. SUGGESTIONS FOR THE OPERATIVE CORRECTION OF SYPHILITIC AND OTHER DEFORMITIES OF THE NOSE.

Dr. John B. Roberts, of Philadelphia, presented this paper, which was read by title. It will appear in a future number of the Annals of Surgery.

TO CONTRIBUTORS AND SUBSCRIBERS.

All Contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 386 Grand Ave., Brooklyn, N. Y.

Remittance for Subscriptions and Advertising and all business communications should be addressed to the

Annals of Surgery,
227–231 South Sixth Street,
Philadelphia.